10 WAYS CHATGPT CAN TRANSFORM YOUR LIFE



NAS DRIVES

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WINDOWS 12

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Expert-level control · No more ads · Ransomware protection · Home worker boosts + 59 more demands



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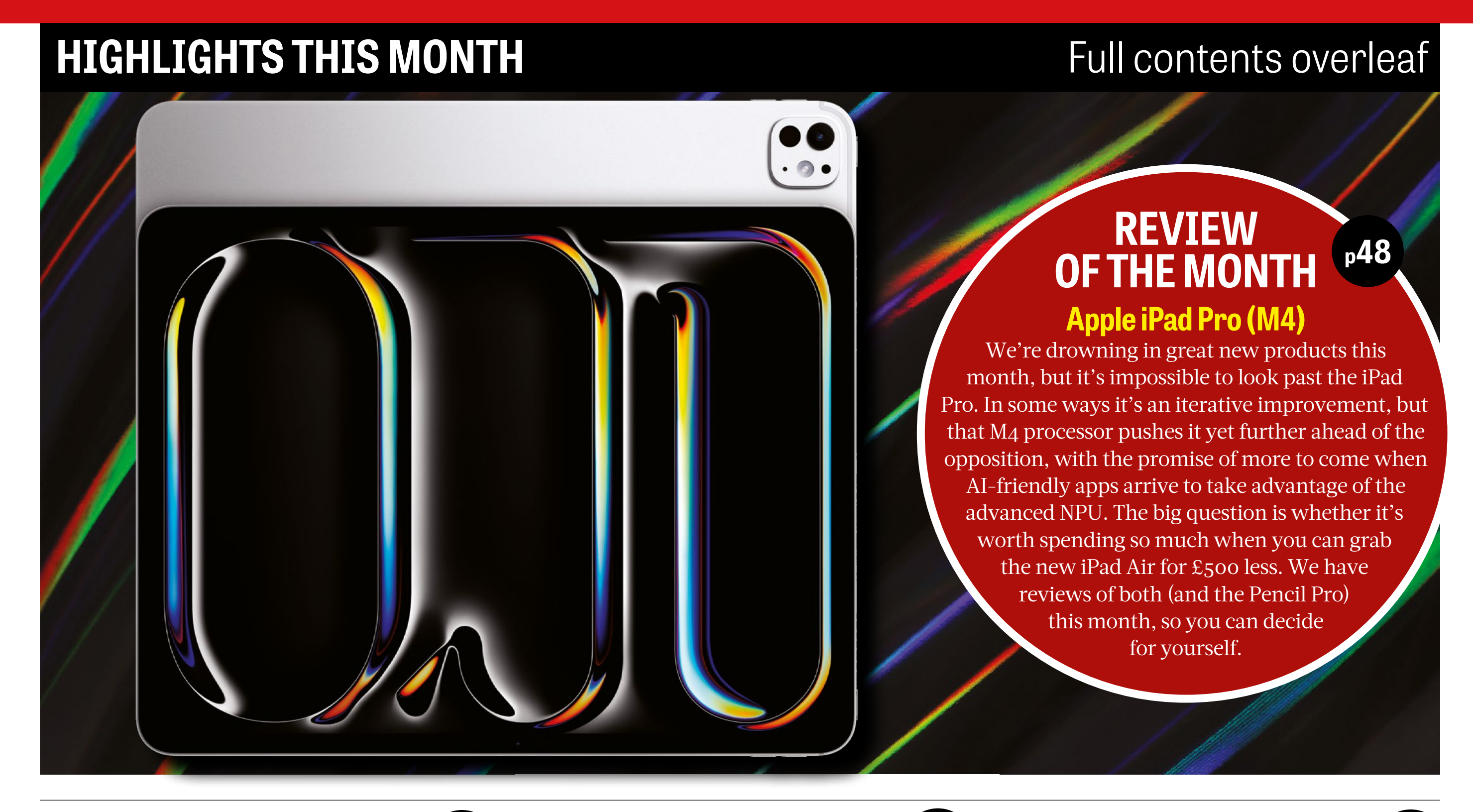


The 980g power laptop

Huawei's Core Ultra 9 stunner

HIGHLIGHTS THIS MONTH

Full contents overleaf

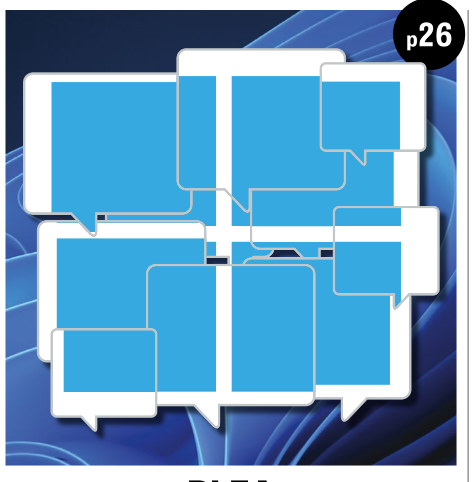


REVIEW OF THE MONTH

p48

Apple iPad Pro (M4)

We're drowning in great new products this month, but it's impossible to look past the iPad Pro. In some ways it's an iterative improvement, but that M4 processor pushes it yet further ahead of the opposition, with the promise of more to come when AI-friendly apps arrive to take advantage of the advanced NPU. The big question is whether it's worth spending so much when you can grab the new iPad Air for £500 less. We have reviews of both (and the Pencil Pro) this month, so you can decide for yourself.



p26

PLEA OF THE MONTH

Windows is at a crossroads: one foot in the past, one eye on the AI future. Microsoft must decide which direction to take, so how lucky that *PC Pro* readers and contributors are here to help.



p34

GADGETS OF THE MONTH

After years in the doldrums, fully functional handheld PCs have arrived. While they're sold as gaming devices, we decided to see if they could be proper productivity machines, too.



p40

CHATGPT TIPS OF THE MONTH

We know there's too much hype about AI, so we challenged Nik Rawlinson to come up with ten practical ways to use ChatGPT (or variants) right now that could genuinely improve our lives.

PEOPLE OF THE MONTH

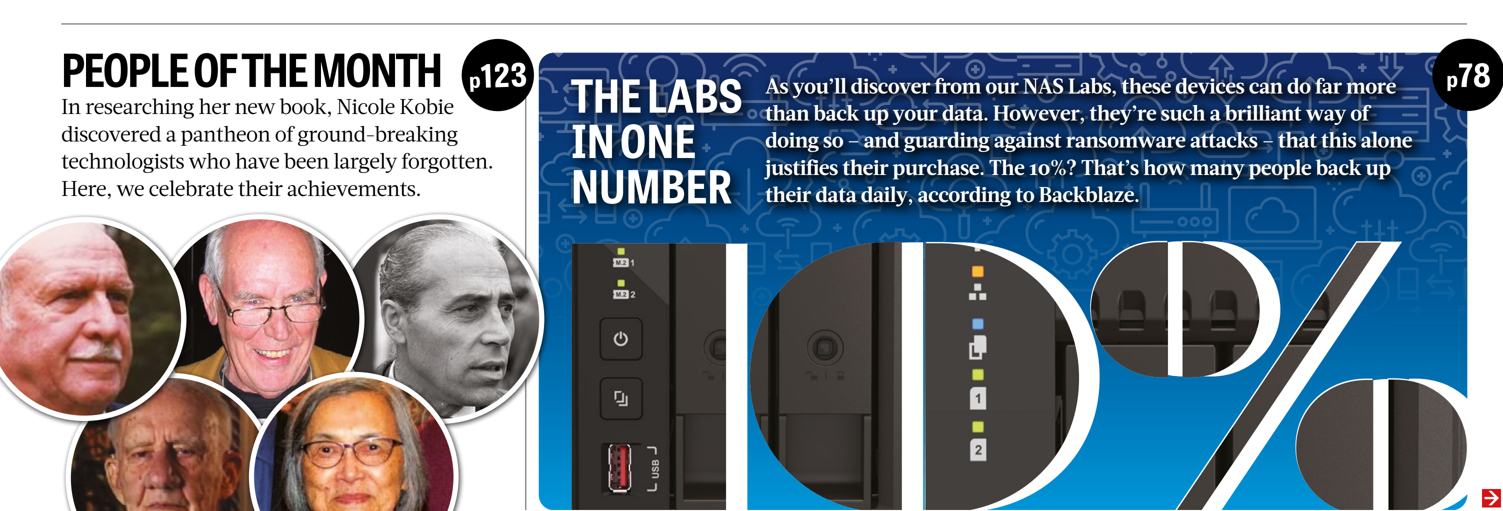
p123

In researching her new book, Nicole Kobie discovered a pantheon of ground-breaking technologists who have been largely forgotten. Here, we celebrate their achievements.

THE LABS IN ONE NUMBER

p78

As you'll discover from our NAS Labs, these devices can do far more than back up your data. However, they're such a brilliant way of doing so – and guarding against ransomware attacks – that this alone justifies their purchase. The 10%? That's how many people back up their data daily, according to Backblaze.





p40 10 WAYS CHATGPT CAN TRANSFORM YOUR LIFE

PC PRO

NAS DRIVES
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REVIEWS THIS MONTH



The Rabbit R1 is a portable assistant powered by AI, but should you hop to it and buy one? Find out on p64





123 Return of the Atari 400
The gaming classic has been revived 45 years after its original release. David Crookes talks to the people that made it happen.

LABS





NAS DRIVES

Whether you're new to NAS drives or looking for something more powerful, our comprehensive buying guide and reviews of 13 of the most popular offerings will help you on your way.

Buyer's guide

96 Desktop scanners 2024
Digitise your archives, streamline your workflows and back up vital information all in one move with a professional scanner.



Futures

126 10 intriguing characters from tech-futures past
Future technologies are built on work from decades ago. Nicole Kobie introduces these should-be famous innovators who helped pave the way for everything from AI and driverless cars to VR headsets, robots and facial recognition.



Copilot needs to tell Microsoft that not everyone wants Copilot

I'm sometimes told by friends that I'm too much of a diplomat. That I try to resolve disputes without causing conflict or risking someone storming off in a great big strop. Well, this is the new me, and the next time I sit down for a little chat with Microsoft I'm going to be brutal. Because it seems that the good people of *PC Pro*-land have had enough. We want change!

Turn to our big article about Windows 12 on p26 and you'll see what I mean. I innocently punted out messages on Discord, Facebook and X to ask our readers what they wanted to see in the next version of Windows, only to be hit by a tidal wave of demands. Few of them will bring a smile to Satya Nadella's face.

All of which makes me wonder: is Microsoft actually listening? On the day before this magazine was split into component atoms and reassembled at the printers – that is, we uploaded some PDFs to a server – our Redmond-based friends announced the Copilot+ PC. If you squint, this addresses one of my concerns about committing to Arm, as Microsoft's new breed of "intelligent Windows PCs" will initially be based on Qualcomm's Snapdragon X Elite chip.

But this is the new non-diplomatic me, and I'm not going to give the benefit of the doubt any more. The truth is that the Copilot+ PC stinks of campus-think, that particular problem that besets American tech giants where they solve problems that only make sense to them, dressed in chinos and sipping mochas while sitting in a boardroom with perfect connectivity, surrounded by glistening computers.

That's not what it's like out here in the real world.

Here, people are making do with laptops and desktops they bought years ago because they don't want to drop a grand on a new PC. They want to keep running the grunting box that has served them so well, the one that will soon be rendered unsafe by Windows 10's lack of security updates and that can't be upgraded to Windows 11 for mysterious, shifting reasons. And they want that PC to run fast. To not be hit with annoying updates and unwanted AI-laden feature packs.

And while I'm at it, here's a mere handful of other things that people are rather keen on. No sneaky ads. Not being tied to Microsoft accounts. Not being force-fed Edge every time a minor update drops. There's more, so much more, in the feature.

Don't misunderstand me. I'm not suggesting we roll back to Windows 7, although even as I type that sentence I wonder whether I subconsciously think we should. But no: I can see a future where we have a great local AI that solves the problems people face. And who knows, perhaps Copilot+ PCs will do that.

But you can't bulk-lift a billion people away from products they like, and, dear Microsoft, surely you know it: just look at Windows 11's market share compared to Windows 10 (26% versus 70% according to **statcounter.com** as I write – and that's a drop in 11's market share compared to last month).

So let me make one simple request. No, a demand: Microsoft, you need to listen to real, genuine people. Only when you do, and only if you ask me very nicely, will we stay friends.

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Editor-in-chief

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This month's main feature looks ahead to what Windows 12 might be, but we asked our to look back in time and answer – what was your favourite version of Windows and why?

"Although I remember Windows 3.1 fondly, Windows 7 is the one for me. It was easy on the eye, easy to use and introduced Windows Snap to the world." (Tim Danton)

"Windows 7, the last version before they started rendering it unusable. I liked being able to pin applications to the taskbar and ClearType font control." (Dick Pountain)

"Has to be Windows 2000 Professional – clean, user-friendly and gloriously robust, with none of the Fisher-Price visual stylings of XP. It deserved a much longer run than it got." (Darien Graham-Smith)

"It's hard to argue against the utterly transformative Windows 95. It was riddled with bugs, but it made PCs mainstream, and without that I wouldn't have had this career!" (Barry Collins)

"Windows 7 was my favourite – mostly because it was the last before everything got weird with tiles and subscriptions and all that confusing mess." (Nicole Kobie)

"Windows XP. Plugging in a USB device for the first time and it just working was a revelation!" (James O'Malley)

"Windows 3.1, but probably more because of what else was happening. Dial-up networking was going mainstream and you could properly explore the internet rather than much of it being funnelled through a handful of providers. You felt like a pioneer." (Nik Rawlinson)

"Server 2003. Maybe that just shows how few web servers I've had to mess with, but '03 was when the vendor-specific drivers really started adding some value." (Steve Cassidy)

"Windows 2000. It had the grown-up stability of NT but with a sprinkle of Windows 98 fun." (Lee Grant)

"NT4 with the exceptional development environment and tools of NeXT OpenStep running on it." (Jon Honeyball)

"Windows Me because it was simply the... Oh, hold on, you said favourite, didn't you?" (Davey Winder)

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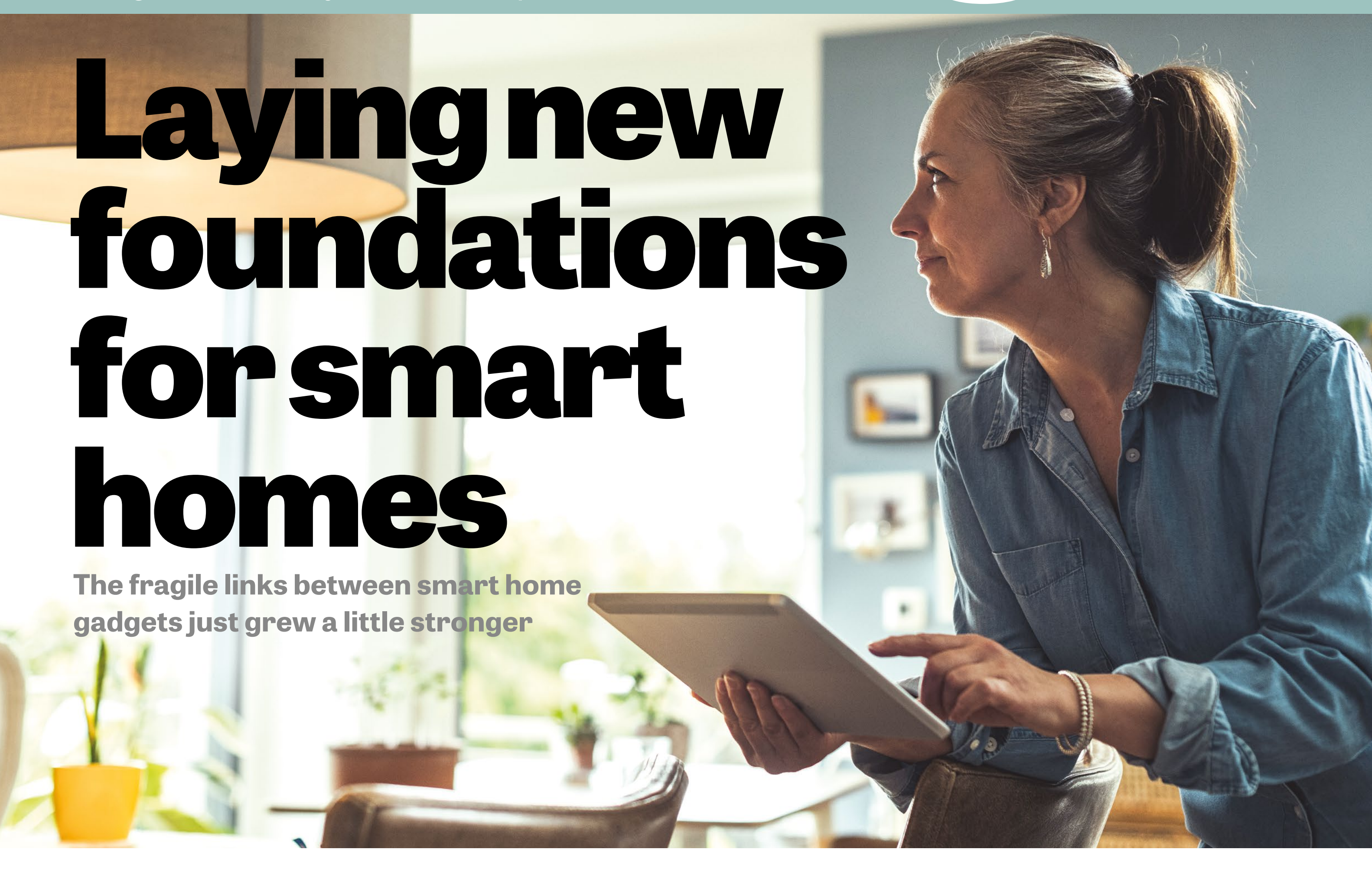
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Laying new foundations for smart homes

The fragile links between smart home gadgets just grew a little stronger

There's a famous *xkcd* web-comic that shows a pile of building blocks precariously balancing on top of a single narrow brick. "All Modern Digital Infrastructure", the pile is captioned – with the brick labelled "A project some random person in Nebraska has been thanklessly maintaining since 2003".

The message, of course, is that our digital infrastructure is more precarious than we might think. And this is especially true in the hobbyist smart home space, with sometimes single GitHub pages holding the crucial code that will connect your smart plugs, blinds and bulbs to the rest of your devices.

Unsurprisingly, this can make the smartest of homes feel like precarious places to be, especially when we're talking about devices that may be mounted to the ceilings or embedded into the walls of our homes, which aren't exactly easy to swap out.

Luckily, then, someone is doing something about it. Paulus Schoutsen, the creator of the popular open-source Home Assistant operating system, which runs every serious hobbyist's smart home, has announced that he's folding his project into a new foundation – the Open Home Foundation – to give his project greater long-term security.

"We're nobody's first smart home system, we're everybody's second," Schoutsen told us, laughing. He first released Home Assistant back in 2013. On the surface, his software is not dissimilar to, say, Apple or Google's Home apps, as a place that draws together smart devices from across your home into one dashboard. (*See issue 357, p26 for more.*)

However, unlike Apple and Google's offerings, Home Assistant is open source and significantly more customisable, enabling wildly complicated automations and integration with different devices and services – each of which is a little like the blocks piled up in the comic described above.

ABOVE Smart homes may be getting smarter thanks to the Open Home Foundation

"We want Home Assistant to exist for the future," said Schoutsen. "We had 240 building blocks when we summed it all up. Some were owned by some other people, and what if these people don't care about these projects any more? What if corporations want to buy them? There's nothing stopping anyone doing any of these, so we felt like we needed to protect that."

Open all hours

Today Home Assistant is largely maintained by his company, Nabu Casa, which operates on a similar model to Ubuntu, where the core project remains open source and free, with the company

> "Unlike Apple and Google's offerings, Home Assistant is open source and significantly more customisable"

offering cloud services and technical support for more commercial users.

This is where the foundation comes into play. The idea behind it is to protect the three major values that have driven Home Assistant to date: that your data remains private, and controls for your devices happen locally on your home network; that you can freely choose which smart devices you want to use, without being locked into specific brands based on your other devices; and long-term sustainability – so that the extractor fan in your bathroom doesn't stop working just because the company that made it goes bankrupt.

"In a way it's a protection from ourselves," joked Schoutsen. "If I go all crazy it shouldn't hurt the Home Assistant project."

> "One idea is to work with the community to build a database of compatible smart home devices"

To ensure the Home Assistant codebase is robust, the new foundation has incorporated a number of other standards and libraries. For example, ESPHome is microcontroller software for chips that are found inside products such as smart plugs and has been brought into the fold.

Similarly, the foundation has partnered more broadly with the teams maintaining other crucial open-source software such as Zigbee2MQTT, which devices such as smart lights sometimes use for control, and WLED, which is software for designing patterns on strips of LED lights. There's even an open-source voice assistant project called Hasspy that has signed up.

The ambitions for the new foundation are bold. For example, one idea is to work with the community to build a database of compatible smart home devices – with each categorised by whether they work locally (without commands going up and down to the cloud), what happens to the data the device collects, and how long users can expect the manufacturer to support the device.

However, there is a limit to Schoutsen's ambitions. "We don't want to maintain more stuff than we need to," he said. "All these things that we have in the Open Home Foundation, if something breaks, we're on the line to fix it. So, we don't want to fold in everything, only the critical parts."

Ultimately, then, there should be someone watching over all of those obscure little dependencies. And you won't have to track them down in Nebraska.

Unicorn spotted driving in London

Billion-dollar investment in British AI driving firm

Britain has a new unicorn! Sadly the term doesn't in this case refer to the pointy horse, but something that the British government hopes is just as magical: a tech firm with a valuation of more than a billion dollars.

Autonomous driving startup Wayve recently announced that it has secured more than $1bn of investment from companies such as Microsoft, Nvidia and Japanese investment fund SoftBank. It was so significant that a press release from the Department of Science, Innovation and Technology heralded the news as a "vote of confidence in [the] UK economy", and included a quote from Prime Minister Rishi Sunak saying: "I'm incredibly proud that the UK is the home for pioneers like Wayve who are breaking ground as they develop the next generation of AI models for self-driving cars."

What makes Wayve's technology unique compared to other autonomy efforts is that it's the first serious attempt to build a self-driving system that uses AI "end-to-end".

The hardware is similar to other systems – the Jaguar I-PACES the company is using to test are equipped with cameras and Lidar sensors. What's different is that instead of the software following predefined "rules" or requiring a detailed virtual map to safely navigate, it's trained from the ground upwards, with the AI intuiting the rules of the road and how to drive responsibly by simply observing training footage.

The upshot of this approach is that the company believes it should be possible for autonomous vehicles fitted with the system to drive themselves in environments where they haven't been before, where no specific preparations for autonomy have been made. The system has been tested in North London, where the company is based, as well as Cambridge, Manchester, Liverpool and Leeds with no extra training required.

The company also believes it could be possible for the AI to adapt to different types of vehicles. In a video posted to the Wayve website, the company claims to have generalised the AI to drive both cars and vans with minimal extra training, even though the two types of vehicle handle very differently.

So, could we be witnessing the next British success story? Now Wayve has a billion-dollar investment to play with, perhaps sometimes life is actually all rainbows and unicorns?



BELOW UK startup Wayve has secured over a billion pounds' worth of funding from the likes of Microsoft, Nvidia and SoftBank

Can Horizon OS become the Windows of spatial computing?

Meta is taking on Apple with a spatial computing OS that's open to all. James O'Malley investigates

If you look up the definition of "rattled" in the dictionary, you might find a photo of Meta (née Facebook) CEO Mark Zuckerberg.

Just days after Apple launched the Vision Pro headset, its $3,499 salvo into the "spatial computing" market, Zuckerberg posted a video to Instagram in which he looked down the barrel of the camera and explained why his company's Quest headset was still the superior choice. Pointing to the price, weight and software library, Zuckerberg concluded: "I don't just think that Quest is the better value, I think the Quest is the better product, period."

Of course, he would say that. But what really made the video interesting was a comment Zuckerberg made later in the video, implying how he saw Meta's future in the spatial computing sector.

"The reality is that every generation of computing has an open and a closed model," he said. "In mobile, Apple's closed model won, but it's not always that way. If you go back to the PC era, Microsoft's open model was the winner, and in this next generation, Meta is going to be the open model, and I really want to make sure that the open model wins out again."

Now, several months on, Zuckerberg appears to be making good on that claim. In a dramatic move at the end of April, Meta announced a "new era for mixed reality" that would see the company break the link between hardware and software.

Going forward, any hardware maker will be allowed to license Meta's newly rechristened Horizon OS as their headset's operating system – much like how OEMs today can use Windows to power their PCs. Both Asus and Lenovo have already signed up and will soon be releasing gaming and productivity-focused headsets respectively.

Are we witnessing the birth of the next Windows or Android? Or is this more Meta hot air?

> "This really is one of Meta's most important strategic moves in virtual and augmented reality for quite some time"

New horizons

"This really is one of Meta's most important strategic moves in virtual and augmented reality for quite some time," said Leo Gebbie, a VR and AR industry analyst at CCS Insight.

Far from being a panicked response to Apple's Vision Pro release, he believes the move was premeditated – perhaps planned as far back as 2014, when Zuckerberg acquired Oculus, one of the early VR pioneers, for $2bn.

"When Meta first bought Oculus, I think it was interested in the potential of virtual reality and the future of this technology," said Gebbie. "It wanted to learn and upskill itself in terms of how these devices worked... but I don't think Meta ever really saw itself long-term as the leading device maker.

"Meta's probably always had an eye on building the ecosystem and operating system level of the Metaverse and running that, and eventually transitioning away from doing hardware."

The Metaverse is hard to define, but broadly speaking it refers to an imagined future evolution of the internet, where we exist in immersive 3D spaces – and in 2021, Zuckerberg announced that Facebook's parent company would be renamed Meta, as he set the company on a mission to build

Quest over for Meta?

Although VR headsets still feel like an emerging product, it's easy to overlook quite how many units Meta has already shipped. It's sold more than 20 million units worldwide – which, for context, roughly matches the sales of the Xbox Series X/S games consoles.

Although that might sound like a success story, it's not doing much for Meta's bottom line. Quite the opposite, in fact. Since acquiring Oculus in 2014, Meta has pumped billions of dollars into Reality Labs, the division of the company responsible for its spatial computing technology. According to CNBC, the business unit has reported losses of more than $45bn (£35bn) since 2020 alone, when the company began reporting its Reality Labs figures separately.



The Quest headset has sold millions of units, but it has yet to make Meta any money

Could opening up Horizon OS be a good excuse for Meta to pull out of making loss-making hardware? "I'm certain it will still continue supporting Quest devices for a few more years," said Gebbie. "I think at some point in the future, it would probably like the majority of the market in terms of hardware to be contributed by other players that are using Horizon OS as a platform."





ABOVE Meta hopes its OS will be used by headset makers

RIGHT Meta CEO Mark Zuckerberg is pushing the open model

this future. Offering Horizon OS to other companies is perhaps the next step in building the hardware ecosystem the vision would require.

"Opening up Horizon OS means that actually, all of a sudden, it can potentially make it far, far easier for device makers to decide if they want to enter the world of virtual reality," said Gebbie. "They can basically spin up a headset very quickly and have a far easier time of launching."

From a strategic perspective, it's consistent with Meta positioning itself as the central software layer – not the company making the headsets. "I think Meta has that appreciation for how difficult [new hardware] is and has realised that actually it can lower the barriers for other players while, of course, providing some benefits to itself," said Gebbie. "One of the key things for Meta here is that if it opens up Horizon OS to other devices, it crucially also opens up access to the Meta [Horizon] Store."

In other words, it is very much an Android-like play, where even though Android is officially open source, the reality is that most Android devices pay a tithe to Google for access to the Play Store and other Google services, and Google earns itself a slice of every transaction.

"Meta has always looked on quite enviously at companies like Apple and Google, who enjoy this share of revenue that comes through spending on their app stores, and I think has always been quite keen to eventually build itself that sort of position," said Gebbie.

The Android question

Perhaps it is easy to imagine a future where Apple owns its own slice of the spatial computing pie and Horizon OS is the Android equivalent, found powering every other headset. But what about Android itself? Doesn't Google want a slice of this pie, too?

"There's no proof whatsoever that Google is making [its] own XR OS," said Tom Ffiske, the writer behind *Immersive Wire*, a newsletter about the VR/AR industry. "There's none. All we know is they are making an XR headset. It's just an assumption which a lot of people have, including myself, as it's exactly what Google would do to be the software layer on the hardware."

Gebbie agrees that it's only a matter of time before Google makes it move. "I think everyone had expected that Google would be the first company to market with an open operating system for spatial computing," he said.

Still, the company has said very little about its plans in this arena. The only serious move in the VR space the company has announced is a partnership with Samsung, with observers assuming that Google is handling the software and Samsung the hardware. Even this may not be "Spatial Android" in the sense that we understand it.

"I think that the operating system on the Samsung headset is going to be incredibly bespoke," said Gebbie. "I think that Samsung and Google have looked at what Apple have done with the Vision Pro and... have seen how well that headset works because of the tight integration of hardware and software, and I think [Google] would have come to the decision that [it needs] to do something similarly bespoke and very closely crafted."

Like Apple, Google also has the benefit of a huge developer base to work with, unlike Meta. "Undoubtedly, Google has an ecosystem advantage in... much the same way that Apple is able to offer the seamless transition of all of your existing apps and content and experiences [to] Vision Pro," said Gebbie. "Google might be able to offer something very similar with an Android-based transition to spatial computing."

> "Google might be able to offer something very similar with an Android-based transition to spatial computing"

However, that advantage might not be decisive because of the complexity of building hardware and software for this new computing paradigm. You need only look at the relative paucity of decent tablet apps for Android to realise that success in the smartphone app market doesn't necessarily translate to other devices, even ones as closely related as smartphones and tablets.

"The know-how to actually run a really well-functioning operating system that's immersive, that's engaging, that's easy to use and understand, I think will require a lot of knowledge and quite a lot of expertise, and I think this is where Meta does have a very good head start," said Gebbie.

There's another big factor that might ultimately decide the winner(s) of this market: price.

"It's still a price-elastic market, where the cheaper headset is the one that gets the most market penetration and growth," said Ffiske. "Meta is still very well positioned to do that compared to other competitors, purely because it has the capital to do so."

The A-List



The best products on the market, as picked by our editors

PREMIUM LAPTOPS

Apple MacBook Pro 16in (2023)

M3 power from £1,699
from apple.com/uk

The M3 chips give the already brilliant MacBook Pro series a boost in games with no sacrifices elsewhere, so power users who are happy with Apple must grapple with the big decisions: which M3 chip, which size of screen, and how much RAM and storage?
REVIEW Issue 352, p46

ALTERNATIVES

NEW ENTRY

Apple Mac Book Air 13in (M3)
Both the 13in and 15in MacBook Airs impress for speed, styling and battery life, but the 1.2kg 13in Air wins out of the two for its sheer portability. **From £1,299 from apple.com/uk**
REVIEW Issue 356, p54

Huawei MateBook X Pro (2024)
Despite weighing just 980g, this laptop packs a 14.2in OLED panel, 2TB of storage and an 11-hour battery life, as well as an Intel Core Ultra 9 processor. **£2,100 from consumer.huawei.com**
REVIEW Issue 358, p60

Asus Vivobook Pro 15 OLED (2024)
A mobile workstation disguised as a slim laptop, the Core i9/RTX 4060 combo provides a staggering amount of power in its high-quality, 1.8kg frame. **£1,600 from uk.store.asus.com**
REVIEW Issue 357, p60

BUSINESS LAPTOPS

NEW ENTRY

Lenovo ThinkPad X1 Carbon Gen 12

Super computer from £1,375 exc VAT
from lenovo.com



The brilliant X1 Carbon range has stepped up a performance gear thanks to Intel's Core Ultra chips, and Lenovo matches it with the stunning build quality and keyboard you'd expect. At 1.1kg, this is a powerhouse ultraportable. Pay the extra for the OLED screen, though.
REVIEW Issue 358, p58

Dell Latitude 7340
This 1.1kg laptop offers terrific battery life and, if you choose the better non-touchscreen (look for 400 nits of brightness in the specs) it's a joy to use, too. **From £1,109 exc VAT from dell.co.uk**
REVIEW Issue 350, p82

Acer TravelMate P6 (TMP614-53)
The all-new TravelMate P6 benefits from a 14in OLED screen with a 2,880 x 1,800 resolution, plus a very generous spec for the price. It's simply great value. **£1,209 exc VAT from acer.co.uk**
REVIEW Issue 350, p80

HP Dragonfly G4
It's not the fastest machine you can buy, but otherwise this 1kg masterpiece is as close as you're going to get to the perfect business laptop for executives. **From £1,380 exc VAT from hp.com**
REVIEW Issue 352, p58

GAMING LAPTOPS

Asus ROG Zephyrus G14 (2024)

Ultraportable gaming from £2,400
from rog.asus.com



Asus' ROG Zephyrus range of gaming laptops has always placed an emphasis on portability, but this sleek 1.5kg laptop takes that to a new level. It maxes out at an RTX 4070, but that's enough to deliver triple-figure frame rates in AAA games – and the 120Hz 14in OLED screen just adds to the speed.
REVIEW Issue 356, p60

ALTERNATIVES

Lenovo Legion 9i Gen 8 (16in Intel)
The liquid-cooling system may be only for bragging rights, but this slim laptop delivers the goods with a superb 16in mini-LED screen. **RTX 4090, £4,180 inc VAT from lenovo.com**
REVIEW Issue 353, p58

HP Omen Transcend 14
This compact, stylish 14in OLED gaming laptop packs a punch thanks to its RTX 4060 graphics. **Part code, 9R292EA#ABU. £1,799 from hp.com/uk**
REVIEW Issue 357, p54

Razer Blade 18 (2023)
A great advert for 18in gaming laptops, the Blade 18 partners a Core i9-13950HX with RTX 40-series graphics. **From £2,900 from razer.com/gb-en**
REVIEW Issue 343, p52

EVERYDAY LAPTOPS

Honor MagicBook 16 X (2023)

Full metal jacket for £700
from hihonor.com



A high-quality all-metal chassis marks the MagicBook 16 X 2023 out from the budget laptop crowd, and it's packed with good-quality (albeit not top-quality) components, from a 12th gen Core i5 chip to a 1,920 x 1,200 16in IPS panel.
REVIEW Issue 348, p59

Asus Vivobook S16 OLED (2024)
A great-value laptop with a 16in 120Hz OLED panel and Core Ultra 7, and it's sleek and stylish, too. **Part code, S5606MA-MX008W. £1,200 from scan.co.uk**
REVIEW Issue 357, p61

Microsoft Surface Laptop Go 2
The Laptop Go 2 won our recent group test of affordable laptops thanks to its high-quality 12.5in screen, 1.1kg weight and sleek design. **£555 from microsoft.co.uk**
REVIEW Issue 347, p89

MSI Prestige 15
Not the most cultured laptop, but great value considering the connectivity, 15in screen, fast specs and a GeForce RTX 3050 GPU (part code A12UC-034UK). **£849 from laptopoutlet.co.uk**
REVIEW Issue 347, p93



CHROMEBOOKS

Acer Chromebook Spin 714

Flipping great for £799

from currys.co.uk



Simply the best Chromebook around. Others may beat the 12th gen Intel Core i5 we tested for performance, but for features, design and bang for buck you won't find any laptop that can match this convertible for £799.
REVIEW Issue 356, p83

Acer Chromebook Plus 515

This Chromebook Plus laptop is all about value. With strong speeds thanks to Intel's Core i5-1235U processor, and a good-quality 15.6in panel with a 1,920 x 1,080 resolution, Asus' Chromebook Plus 515 is ideal for families, students and business users, providing mobility isn't your main priority as it isn't particularly light at 1.7kg. **£429 from currys.co.uk**
REVIEW Issue 356, p82

Lenovo IdeaPad 5i Gaming Chromebook Plus

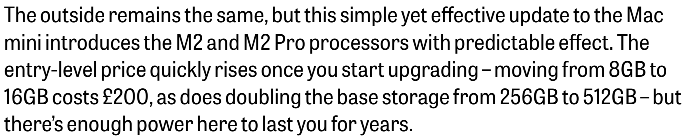
The 120Hz 15.6in display is the star of this Chromebook, as it should be with 2,560 x 1,600 pixels to play with. You're getting a lot of laptop for the price, too, including a 512GB SSD, Core i5-1235U processor and 8GB of RAM. Just note the 1.9kg weight.
£659 from very.co.uk
REVIEW Issue 356, p88

EVERYDAY PCs

Apple Mac mini (2023)

M2 masterpiece from £649

from apple.com/uk



The outside remains the same, but this simple yet effective update to the Mac mini introduces the M2 and M2 Pro processors with predictable effect. The entry-level price quickly rises once you start upgrading – moving from 8GB to 16GB costs £200, as does doubling the base storage from 256GB to 512GB – but there's enough power here to last you for years.
REVIEW Issue 343, p60

Intel NUC Pro 13

If you don't need discrete graphics then Intel's mini PCs are a fantastic choice, being easy to upgrade, low on energy consumption and more than powerful enough to cope with Windows applications – despite being little larger than a coffee coaster.
Barebones, from £350; full PCs, from £600, from scan.co.uk
REVIEW Issue 345, p48

PCSpecialist Fusion Elite P

A promising debut for AMD's Ryzen 8600G processor, this quiet-running, power-efficient system packs in lots of performance considering it costs so little. And a slot sits empty for a future graphics card upgrade should the built-in graphics prove insufficient for your gaming needs. **£649 from pcspecialist.co.uk/reviews**
REVIEW Issue 355, p54

ENTHUSIAST PCs

Cyberpower Ultra R77 RTX Gaming PC

RTX Super 4080 power for £2,275

from tinyurl.com/356cyber



The striking case catches the eye, but it's the potency of AMD's Ryzen 7 7800X3D and Nvidia's RTX 4080 Super graphics that leave the lasting effect.
REVIEW Issue 356, p62

HP Omen 45L (2023)

We tested the top-end 45L with a Core i9-13900K, GeForce RTX 4090 graphics and 64GB of RAM, and it doesn't come cheap. Switch to the Core i7/RTX 4070 Ti version, however, and the price almost halves without losing any of the superb design and build quality. **£4,800 from hp.co.uk**
REVIEW Issue 347, p50

Alienware Aurora R16

An understated yet stylish gaming PC that runs quietly even when pushed. This rig has power where it counts, mixing Intel's latest CPUs with Nvidia's RTX GPUs. Choose an RTX 4070 or higher to benefit from the glass side and liquid cooling, which lifts it above rivals. **From £1,349 from dell.co.uk**
REVIEW Issue 349, p54

ALL-IN-ONE PCs

HP Envy 34 All-in-One

£2,099 widescreen wonder

from hp.com



Built around a high-quality 34in widescreen – which is perfect for viewing two windows side by side thanks to its 21:9 aspect ratio – this also comes with Nvidia RTX 3060 graphics. We're big fans of the magnetic 16-megapixel camera, too.
REVIEW Issue 335, p46

Dell Inspiron 24 All-in-One

Despite being built to hit a price point, the Inspiron 24 All-in-One manages to look classy, include a good-quality, 1,920 x 1,080 24in panel and have enough power to breeze through a typical day's tasks. It even packs mod cons such as a 720p webcam. Superb value for money.
From £599 from dell.co.uk
REVIEW Issue 350, p47

Apple iMac 24in (M3)

The iconic design remains the same, but the plain M3 chip inside the revamped iMac 24in is a revelation compared to the previous M1 version. The downside is that the base configuration includes a stingy 8GB of memory and a 256GB SSD.
From £1,399 from apple.com/uk
REVIEW Issue 352, p52

CREATIVE WORKSTATIONS

Scan 3XS GWP TR Ada

Record breaker for £14,167 exc VAT

from scan.co.uk



A 64-core Ryzen Threadripper 7980X blows everything that went before out of the water with multithreaded tasks, while Nvidia's RTX 6000 Ada graphics dominates for viewport acceleration and GPU rendering. Even storage throughput is unparalleled. With a striking chassis and brilliant build quality, you'll want for nothing.
REVIEW Issue 353, p52

Armari Magnetar MC16R7

A strikingly fast workstation for the money, with Armari's customised liquid cooling extracting the most from an AMD Ryzen 9 7950X. With 64GB of DDR5 RAM and AMD's Radeon Pro W7800 in support, this is a fantastic value machine.
£3,758 exc VAT from armari.com
REVIEW Issue 348, p84

PCSpecialist Onyx Pro

Even in a creative workstation, it makes a lot of sense to include Nvidia's consumer graphics due to its core-per-buck. Here, an Nvidia RTX 4090 partners with a Core i9-13900K and an incredible 192GB of RAM to tremendous effect. **£3,750 exc VAT from pcspecialist.co.uk/reviews**
REVIEW Issue 348, p86

TABLETS

NEW ENTRY

NEW ENTRY

Apple iPad Air (M2)

M2 power from £599

from apple.com/uk

We love the new iPad Pro, but for most people the M2 iPad Air is not only far better value but also all the tablet they'll need. It supports the Magic Keyboard and Pencil Pro, plus it's now available in both 11in and 13in sizes.

REVIEW Issue 358, p50



Apple iPad Pro (M4)

The best tablet in the world becomes even better thanks to Apple's stunning M4 chip, a gorgeous OLED screen and the must-have accessory: the all-new Pencil Pro. But it comes with an obvious downside of cost, with the cheapest 13in incarnation costing £1,299. **From £999 (11in, 256GB) from apple.com/uk**

REVIEW Issue 358, p48

OnePlus Pad

The OnePlus fully justified its place in our luxury tablet Labs thanks to its outstanding build quality, slick performance and stunning 17-hour battery life. It's the best Android option outside of Samsung's Galaxy Tabs – and it won't do nearly so much damage to your wallet. **£449 from oneplus.com**

REVIEW Issue 352, p86

EVERYDAY PHONES

NEW ENTRY

NEW ENTRY

Motorola Moto G54 5G

Great looker for £180

from johnlewis.com

The 6.5in 120Hz IPS display is the G54's standout feature, but it improves on the previous generation in numerous ways while being even cheaper. It's faster, looks better, takes great photos and battery life is strong. You won't find better for less than £200.

REVIEW Issue 355, p77



Google Pixel 8a

We're fans of the Pixel 8 but you can save £200 and buy the 8a without missing out on any key features, including its advanced AI skills thanks to the same Tensor G3 chip inside. It's only when you zoom into snaps that you spot the camera quality difference. **128GB, £499 from store.google.com**

REVIEW Issue 358, p74

Samsung Galaxy A55

Not the fastest phone on the market, but in return you get a high-quality 6.6in OLED display, excellent battery life and a trio of strong cameras. And you also get four years of feature updates. With a price that significantly undercuts the Pixel 8a, it's great value, too. **128GB, £364 from johnlewis.com**

REVIEW Issue 358, p77

PREMIUM PHONES

Samsung Galaxy S24 Ultra

AI cleverness from £1,249

from samsung.com/uk

The undeniably high price gets you a bunch of AI tools that will genuinely save you time (and money). While we miss the 10x optical zoom of the S23 Ultra, the 5x zoom camera and supporting cast capture brilliant images, while the S Pen is always on hand to scrawl notes and pictures.

REVIEW Issue 354, p58



Google Pixel 8

It's not a huge step up from the Pixel 7, but the added AI features are genuinely useful and it benefits from a handful of upgrades, too – including a 120Hz screen and the new Tensor G3 processor. If you don't mind the lack of optical zoom, it's a great buy for the price. **128GB, £699 from store.google.com**

REVIEW Issue 351, p72

Samsung Galaxy Z Flip5

While the Galaxy Z Fold5 has its undoubted attractions, the Flip5 pips it onto this A List slot thanks to it being £700 cheaper and through the usefulness of the expanded front display. It's also IP68 rated and packs a stellar chip, beating rival flip phones. **From £1,049 from samsung.com/uk**

REVIEW Issue 349, p70

EVERYDAY MONITORS

Iiyama ProLite XUB3293UHSN-B5

32in 4K bargain, £429

from currys.co.uk

The fact that this 31.5in IPS monitor could compete so well against Eizo's alternative (*see below*) says it all. Great colour coverage in sRGB and DCI-P3, USB-C and RJ45 inputs, plus solid build quality add up to a bargain.

REVIEW Issue 357, p88



BenQ BL2790QT

A 27in, 1440p monitor that's packed with quality, from its brilliant OSD to several clever features designed to fight eye fatigue. Text and images look sharp and punchy, its USB-C docking capability is always welcome, and the speakers are surprisingly decent. **£270 from laptopsdirect.co.uk**

REVIEW Issue 357, p85

Acer Verso B277 Ebmiprzxv

This is a basic but high-quality monitor, delivering colourful images across its 27in Full HD diagonal. You don't get USB-C docking, but it includes VGA, HDMI and DisplayPort inputs, plus a two-port USB hub. **£149 from tinyurl.com/357acer277**

REVIEW Issue 357, p84

PROFESSIONAL MONITORS

Eizo FlexScan EV3240X

Stunning 4K quality, £1,206

exc VAT from photospecialist.co.uk

With images that whack you between the eyes as soon as you lift it, fully assembled, from its box, this 32in 4K monitor is our top choice pick for anyone willing to make such a hefty long-term investment.

REVIEW Issue 357, p91



Eizo ColorEdge CG2700X

A brilliant choice for professional designers, whether working solo or in teams, thanks to its dedication to providing accurate colours across potentially years of life. It's also bang up to date for connectivity, with USB-C and RJ45 making it easy to manage, too. **£2,149 exc VAT from wexphotovideo.com**

REVIEW Issue 357, p90

BenQ PD2706U

If you can't stretch to Eizo budget levels then this 4K 27in screen is definitely worth investigating. It has several features aimed at professionals, including a Hotkey Puck to switch between profiles, plus great coverage of the sRGB and DCI-P3 gamuts. **£333 exc VAT from scan.co.uk**

REVIEW Issue 357, p86



WEBCAMS

Logitech MX Brio 705 for Business

Consistent brilliance for £219

from logitech.com



Consistent image quality in all lighting conditions coupled with top build quality and nifty features – such as a presenting mode for items on your desk – make this a fantastic all-round choice.
REVIEW Issue 356, p68

Aukey PC-W3 1080p Webcam

If the thought of spending £219 on a webcam has you spluttering into your microphone then you should consider this far cheaper but high-quality alternative. Its colours are low-key in comparison to the best, but it still produces a sharp and detailed image. **£13 from ebay.co.uk**
REVIEW Issue 321, p72

Obsbot Tiny 2

This portable 4K webcam delivers for quality, design and sharpness, and it comes with a shedload of advanced features, including dynamic zoom and subject tracking. The only real downside is that it has a price that reflects its premium ambitions.
£329 from amazon.co.uk
REVIEW Issue 352, p75

HOME OFFICE PRINTERS

Epson EcoTank ET-2830

Ink tank all-in-one for £250

from epson.co.uk

Don't expect flashy features, but do expect fast print speeds, high-quality prints, scans and copies, plus phenomenally low running costs – even after you've exhausted the 6,000 pages' worth of bottled ink that comes with it.
REVIEW Issue 353, p85

Canon Pixma TS8750

A fantastic choice for creative users that's equally at home printing photos as it is scanning artwork. Despite its high running costs, due to its reliance on cartridges, this is a superb all-in-one. **£159 from printerbase.co.uk**
REVIEW Issue 353, p86

HP OfficeJet Pro 9012e

So long as your print volumes aren't huge – the running costs mount up – this is a superb all-in-one for home office usage. It's fast, robust, prints double-sided and produces strong all-round results.
£208 from printerland.com
REVIEW Issue 353, p87

WORKGROUP PRINTERS

Canon Maxify GX6550

Ink tank all-in-one for £392 exc VAT

from canon.co.uk



Designed to fit in tight spaces, this all-in-one includes a highly effective ADF and backs it up with high-quality prints at 24ipm in our tests. Running costs are superb, too.
REVIEW Issue 350, p58

Brother HL-L9430CDN

This laser printer (not an all-in-one, so there's no scanning or copying functionality) is a great choice for a busy office, producing sharp black text and making a good job of colour graphics as well. All while doing so quickly with a competitive price per page. **£415 exc VAT from printerland.co.uk**
REVIEW Issue 353, p84

Xerox B315DN

A fine alternative to the Brother and Canon, this mono laser multifunction printer produces superb results at great speed – 27.5 pages per minute in our 50-page test, which includes the spool time. It's similarly quick for scans, with a dual-CIS ADF to speed up double-sided copies. **£238 exc VAT from printerbase.co.uk**
REVIEW Issue 341, p87

WIRELESS ROUTERS

Netgear Nighthawk RAXE300

Fast Wi-Fi 6E router, £350

from amazon.co.uk

The RAXE500 is faster than the RAXE300, but in practice we doubt you would notice – this tri-band router still delivered speeds between 50MB/sec and 150MB/sec in our tests. And it's packed with features, too. At £150 cheaper than its bigger brother, we think it hits the Wi-Fi 6E sweet spot.
REVIEW Issue 341, p68

Netgear Nighthawk RS700S

Make no mistake – you won't get stunning speeds out of this Wi-Fi 7 router today. But if you must buy a router now and want future-proofing, this is a solid choice. But honestly, we would recommend that you wait.
£800 from netgear.com
REVIEW Issue 353, p76

Asus RT-AX59U

You can buy cheaper Wi-Fi 6 routers – such as the D-Link Eagle Pro AI R15 for £55 – but Asus' well-priced offering delivers strong performance along with lots of control and exceptional VPN support. **£125 from uk.store.asus.com**
REVIEW Issue 350, p57

MESH WI-FI

TP-Link Deco XE200

Clever Wi-Fi 6E for £600

from amazon.co.uk



There are cheaper Wi-Fi 6E meshes, but the XE200 wins for its superb download speeds, excellent coverage and the fact that older clients reap benefits of 6E, not just new ones. And a two-pack (code B0BKTDPWC8) should be enough for most premises.
REVIEW Issue 349, p65

Mercusys Halo H80X

A new subsidiary of TP-Link, Mercusys offers its parent brand's XE75 router some excellent value-for-money competition. Not as fast due to Wi-Fi 6 rather than Wi-Fi 6E, but it has all the bandwidth you need for everyday use and should deliver it stably throughout your house. There are plenty of features too. **2-pack, £161 from ebuyer.com**
REVIEW Issue 341, p71

Linksys Velop Pro 6E

Ironically, this Wi-Fi 6E router will get the most out of your non-Wi-Fi 6 devices thanks to its use of the 6GHz network for station-to-station traffic. And you only need two units for rock solid performance across a three-bedroom house. **2-pack, £380 from amazon.co.uk**
REVIEW Issue 350, p54



BUSINESS WI-FI

Zyxel WAX640S-6E

Wi-Fi 6E AP, £369 exc VAT

from broadbandbuyer.com



A nicely priced tri-band wireless access point ideally suited to businesses that want to provide the full range of wireless services. It's easy to deploy, wireless performance is good and Zyxel provides top-quality cloud management services.
REVIEW Issue 353, p100

Asus ExpertWiFi EBM68

Small businesses will find much to like with this simple-to-manage Wi-Fi 6 access point. AiMesh makes it incredibly easy to expand wireless coverage, performance is reasonable and it includes an impressive range of network security features. **2-pack, £540 exc VAT from amazon.co.uk**
REVIEW Issue 353, p98

Netgear WAX625

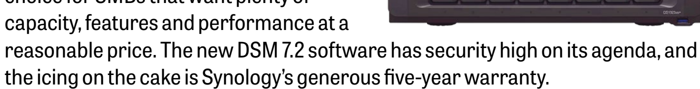
A great choice for SMBs seeking an easy wireless performance boost with minimum investment. This is an affordable Wi-Fi 6 AP with good speeds while Netgear's Insight provides smart cloud management services. **£224 exc VAT from broadbandbuyer.com**
REVIEW Issue 353, p99

NAS SERVERS

Synology DiskStation DS1823xs+

10GbE NAS, £1,413 exc VAT

from broadbandbuyer.com



This powerful eight-bay NAS is a great choice for SMBs that want plenty of capacity, features and performance at a reasonable price. The new DSM 7.2 software has security high on its agenda, and the icing on the cake is Synology's generous five-year warranty.
REVIEW Issue 346, p101

Qnap TS-h987XU-RP

The TS-h987XU-RP is a ready-made hybrid storage solution for SMBs. This rack-friendly package offers a great specification for the price, and Qnap's QuTS hero software scores highly for its wealth of data-protection features and business apps. **Diskless, £3,292 exc VAT from broadbandbuyer.com**
REVIEW Issue 344, p96

Synology DiskStation DS1522+

Small businesses that want a high-capacity desktop NAS at a good price will find Synology's DS1522+ a great choice. Performance over 10GbE is impeccable and the DSM software offers a fantastic range of storage features. **5-bay NAS, diskless £586 exc VAT from broadbandbuyer.com**
REVIEW Issue 344, p98

VIDEOCONFERENCING

Poly Studio X52 with TC10

Perfect middle man, £3,161 exc VAT

from meetingstore.co.uk

Ideal for businesses that want a professional videoconferencing solution for medium-sized meeting rooms. Video quality is excellent, speaker tracking fast, and the big choice of built-in VC apps makes it incredibly versatile.
REVIEW Issue 353, p102

Owl Labs Owl Bar

As a standalone videoconferencing room solution the Owl Bar has plenty to offer, with good video quality and super-smooth speaker tracking. It really comes into its own when paired with an Owl 3, though, as this unleashes a completely new dimension to your meetings. **£1,999 exc VAT from owllabs.co.uk**
REVIEW Issue 352, p99

Jabra PanaCast 50

This sleek cylinder delivers great video and audio quality, fast speaker tracking and a wealth of advanced features. Jabra's Xpress web portal offers smart remote management services, and the super-wide view helps make the PanaCast 50 ideal for all-inclusive meetings. **£867 exc VAT from uk.insight.com**
REVIEW Issue 354, p100

SCANNERS

NEW ENTRY

Xerox N60w Pro Scanner

Speed demon, £766 exc VAT

from tradescanners.com



The N60w Pro offers tremendous value and versatility. It delivered up to 67ppm in our tests with great output quality, offers a plethora of connection options and makes walk-up scanning a breeze.
REVIEW Issue 358, p101

NEW ENTRY

Brother ADS-4500W

Ideal for small businesses, the ADS-4500W offers a fine set of walk-up scan features and its output quality is beyond reproach, while Brother's Print&Scan app delivers great scan workflow management options. **£295 exc VAT from printerbase.co.uk**
REVIEW Issue 358, p98

NEW ENTRY

Epson WorkForce ES-C320W

A space-saving wireless desktop scanner, the Epson WorkForce ES-C320W delivers nippy speeds – around 31ppm in our tests – and is backed with software that offers plenty of scan management features. **£180 exc VAT from printerland.co.uk**
REVIEW Issue 358, p100

SERVERS

Dell EMC PowerEdge T350

Xeon E-2300 power, from £1,399 exc VAT

from dell.co.uk



Perfect for SMBs and branch offices looking for an affordable and powerful single-socket tower server. Along with support for Xeon E-2300 CPUs and lots of memory, it has a high storage capacity, plenty of expansion space and is sturdily built.
REVIEW Issue 335, p98

Dell EMC PowerEdge R250

With prices starting at around £850 exc VAT for a Pentium Gold CPU, and the option of Xeon E-2300 series chips from £1,461 exc VAT, this is a slim, rack-mounted alternative to the more high-powered T350 that's ideal for SMBs. **From £845 exc VAT from dell.co.uk**
REVIEW Issue 332, p98

Broadberry CyberServe Xeon E-RS100-E10

This represents a powerful hardware package at a price that will please small businesses. We love its low-profile chassis and the fine selection of remote-management tools. It's a great alternative to the Dell EMC servers also listed here. **£983 exc VAT from broadberry.co.uk**
REVIEW Issue 318, p96

SECURITY SOFTWARE

Avast Ultimate
Buy from retail and this is a bargain, with a solid VPN, anti-tracking software and handy detection fees on top of excellent protection. **10 devices, 2yrs, £30 from store.pcpro.co.uk**
REVIEW Issue 355, p84

G Data Total Protection
G Data provides straightforward, effective and inexpensive protection against malware and other threats to your system, making it a favourite despite its quirks. **5 devices, $82 from gdatasoftware.co.uk**
REVIEW Issue 355, p87

Avast One Essential
Avast One Essential has the same malware-detection engine as our top choice, but for free. It even includes 5GB of VPN services per month and a few system optimisation tools. **Free from avast.com**
REVIEW Issue 355, p89

VPNs

NordVPN
NordVPN won our VPN Labs for the second time running thanks to its consistent, fast speeds, great security features and excellent support for video streaming. **£80 for two years from nordvpn.com**
REVIEW Issue 349, p86

ProtonVPN
The best free VPN service available, with quick speeds and unlimited bandwidth. The paid-for service isn't cheap, but offers a bunch of useful extra features that might just tempt you into coughing up. **Free from protonvpn.com**
REVIEW Issue 349, p88

Surfshark
The fastest VPN we've tested, and it's generally a good performer in our region-shifted streaming tests, too. Cancellation is trickier than it should be, but it's a great-value choice for heavy VPN users. **£56 for two years from surfshark.com**
REVIEW Issue 349, p89

PASSWORD MANAGERS



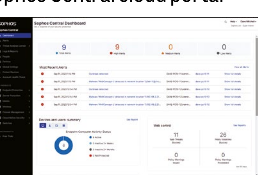
NordPass
This hassle-free option is a great choice for both personal and business use, with a competitive price matched with all the features most people need. **£1.89 per month from nordpass.com**
REVIEW Issue 350, p70

Bitwarden
Free for individual use and open source, the only important thing Bitwarden lacks is phone support: it works with virtually every device and browser, and the paid option is well worth £10 per year. **Free from bitwarden.com**
REVIEW Issue 350, p71

Keeper
A great choice for businesses thanks to its focus on security and a zero-knowledge policy, and if you need more options then Keeper has them. **Business edition, from £2 per user per month from keepersecurity.com**
REVIEW Issue 350, p72

ENDPOINT PROTECTION

Sophos Intercept X Advanced
Delivers a huge range of endpoint protection measures for the price. It's simple to deploy, device and user policies add flexibility, and seamless integration with the Sophos Central cloud portal makes management simple. **500-999 users, 1 year, £36.50 each exc VAT from enterpriseav.co.uk**
REVIEW Issue 351, p98



WithSecure Elements EPP and EDR
High levels of automation make WithSecure a great choice for SMBs that want endpoint protection on a plate. It's easily managed from the cloud, too. **100-499 devices, £37 each per year exc VAT from withsecure.com**
REVIEW Issue 351, p99

CLOUD STORAGE

ShareFile Premium
Cloud file-sharing features are on a par with many other solutions, but ShareFile Premium stands out for its generous 100GB file size support. Admin features and access security are extensive, and the new pricing structure makes it even more affordable. **£19.60 exc VAT per user per month from sharefile.com**
REVIEW Issue 355, p100



Tresorit Business Plus
Tresorit's strict zero-knowledge encryption policy, excellent value and ease of use make it a great choice for security-conscious SMBs. **£12.83 exc VAT per user per month from tresorit.com**
REVIEW Issue 355, p101

VOIP SERVICES

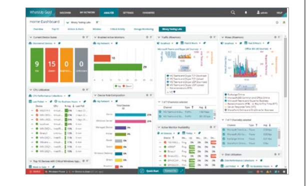
3CX Phone System V20
Our top choice for businesses that want to manage their own VoIP system. It can be hosted in the cloud or on-premises, and has lots of new features. **Small Business, 10 users, £175 exc VAT per year from 3cx.com**
REVIEW Issue 357, p98



TelephoneSystems.Cloud
A great choice for businesses that know what they want from cloud-hosted VoIP services, offering a wealth of features at a competitive price. **From £11 exc VAT per user per month from telephonesystems.cloud**
REVIEW Issue 357, p100

NETWORK MONITORING

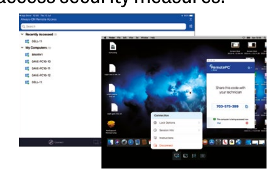
Progress WhatsUp Gold 2023.1
Simple to deploy and offers an impressive range of network-monitoring tools. The choice of licensing plans makes it an affordable option for SMBs, and support teams will love its smart dashboard and NOC views. **Enterprise, 50 devices, £1,192 exc VAT per year from whatsupgold.com**
REVIEW Issue 354, p99



Paessler PRTG Network Monitor 23.4
A highly versatile network-monitoring package that delivers a wealth of information, and its all-inclusive price makes it a great choice for SMBs. **1,000 sensors, 1yr maintenance, €2,649 exc VAT from paessler.com**
REVIEW Issue 354, p98

REMOTE SUPPORT

IDrive RemotePC Team
IDrive's RemotePC Team will appeal to SMBs that want affordable cloud-hosted remote support for their offices and home workers. It's exceedingly simple to deploy, easy to manage and delivers tough access security measures. **First year, 50 computers, £172 exc VAT from remotepc.com**
REVIEW Issue 349, p98



NetSupport Manager 14
Delivers a wealth of support tools, including secure access to home workers, and licensing plans are good value. **1-500 systems, perpetual licence, £10 each exc VAT from netsupportmanager.com**
REVIEW Issue 349, p100

UTM APPLIANCES

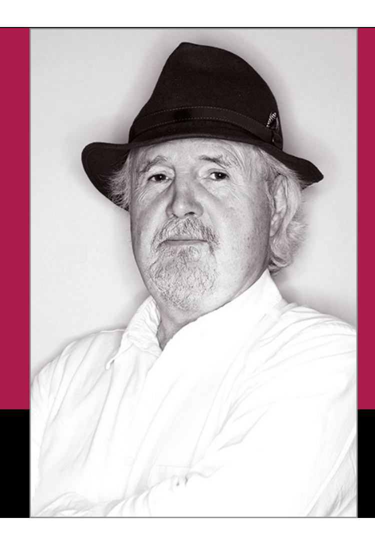
WatchGuard Firebox T45-CW
Businesses that hate internet downtime will love WatchGuard's Firebox T45-CW. It provides a wealth of top-class security services, can be easily cloud managed and delivers seamless 5G WAN failover. **Appliance with 3yr TSS, £4,015 exc VAT from broadbandbuyer.com**
REVIEW Issue 354, p103



Zyxel ZyWALL ATP500
This desktop appliance gives sophisticated protection against zero-day threats, is easily managed and very good value. **Appliance with 1yr Gold Security licence, £1,191 exc VAT from broadbandbuyer.com**
REVIEW Issue 348, p99



A "smart" TV upgrade has turned my air blue



Dick Pountain is editorial fellow of *PC Pro*. He is now convinced that smart TV is an oxymoron. Email dick@dickpountain.co.uk

The combination of Bluetooth's quirky ways and a new television puts Dick's relationship with his wife and neighbours on the rocks

In my back-room hardware morgue is a black cotton bag, about the size of Santa's sack, containing nothing but cables. This unwholesome collection bears witness to a long career in personal computing: RS-232 serial, parallel printer, Cat3 and Cat5 Ethernet, BT telephone, USB, phono, Scart, HDMI, composite video cables and more. As a long-time fan of dub reggae, seeing it always prompts me to put on the Bag-O-Wire album.

My home/office has been almost wireless for years, ever since the advent of Wi-Fi and Bluetooth, and while that's generally a very good thing, it's not quite problem free. I listen to a lot of music and am fussy about sound quality, so I route all my sources through a hi-fi system with vintage Castle speakers. But I don't only listen to music, I also make it, using several guitars and a small Marshall amplifier.

Until recently, my last remaining wired connection was from an outdated LG smart TV to my hi-fi amplifier, which has Bluetooth but supports only one connection at a time – a connection that was occupied by my laptop for Spotify and YouTube. I tried a Bluetooth dongle in the TV's headphone output, but the switching involved proved more inconvenient than running a wire under the rug. Then that TV died and I replaced it with a new one with Bluetooth built in. And so the fun began.

The IT industry has come up with a fair number of dodgy protocols, but by far the most perplexing to me is Bluetooth, which often appears to have a (malignant) mind of its own.

> **"The IT industry has come up with a fair number of dodgy protocols, but by far the most perplexing is Bluetooth"**

In a couple of recent columns I've mentioned Albert Einstein's dislike of "spooky action at a distance". Well, to me Bluetooth is snooty action at a distance: it connects only when it feels like it and if you don't irritate it. (I Googled SAAAD and, in addition to the Einstein reference, I discovered it also stands for South African Academy of Aesthetic Dentistry, a spooky connection.)

Now, having a spare Bluetooth dongle, I thought it would be nice to plug it in the line output of my guitar amp, so I could practise later at night using my JBL wireless headphones. I paired these but my first test was explosive. The guitar output actually came out of the hi-fi at a colossal volume, but I was wearing over-ear headphones which attenuated the sound so much that it took me a devastating and near marriage-breaking while to realise this. By some queer coincidence, neighbours no longer return my cheery morning wave.

Turns out the dongle is happy to talk to the hi-fi amp but not the headphones. The same happened with the new TV, where I could use the headphones, but only by manually disconnecting the hi-fi amp via my laptop (which didn't work for the guitar amp).

I also own a Samsung tablet that I use, among other things, to run a MIDI sequencer app on which I write bass, drum and occasionally piano tracks to play along to. Shift the Bluetooth dongle from the guitar amp's output to an input channel – and switch it from Tx to Rx – and it talks to the tablet perfectly! But that same tablet won't pair with my laptop! I may be getting hysterical! And my teeth may be turning blue through excessive swearing!

> **"A pandemic of streaming services has rendered TV viewing a nightmare, with screen after screen full of horrid thumbnails for trashy programmes"**

The problem is twofold. Some devices are picky about what they'll pair with, possibly due to Bluetooth version clashes, which often aren't easy to ascertain. But also most small Bluetooth devices have no user interface to make visible what else is going in the Toothosphere. I expect someone will write in to say none of this is a problem if you buy all of your kit from Apple, Sonos or whoever, but I'm not interested in wiring the whole house for muzak, merely to connect the existing kit I've selected over the years.

I've now reached a reasonable equilibrium. My new Panasonic telly has Dolby sound good enough that I don't need to Bluetooth it to the hi-fi. The wireless MIDI sequencer works a treat as accompaniment. And I've dug out a pair of wired Sony headphones for late night practice. All this I can live with.

What I can't live with is the traumatic experience that buying an up-to-date smart TV has become. In the few years between my old LG and this Panasonic, a pandemic of streaming services has rendered TV viewing a nightmare, with screen after screen full of horrid thumbnails for trashy programmes on crummy networks, almost all of which want you to subscribe. This new set regards watching live TV channels as some kind of perversion that it tries to hide away from you. But that's a topic for another column, on Cory Doctorow's concept of "enshittification" and the plague of rent-seeking.

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LinkedIn 2024: machines writing, machines reading

The future of the web is in early preview on LinkedIn, and unless you like AI-regurgitated posts about people's achievements it sure ain't pretty



Nicole Kobie is *PC Pro*'s Futures editor. She's on LinkedIn, where you can send an AI-written message for her to ignore.
@njkobie

When I open up Twitter, aka X, it's mostly people I don't remember following shouting about an issue I don't care about – and that they won't care about tomorrow. So I heave a deep sigh, log out and try Instagram; but that's all brands and influencers these days, with real people posting less and less. I attempted to get into Threads, back when it started, but it was mostly chat about why Threads was better than Twitter, so I quickly gave up.

LinkedIn, though, always has notifications for me. And everyone loves a notification. There's only one problem: I'm pretty sure it's turned into ChatGPT talking to itself.

I've never used LinkedIn much, mostly to keep up with who works where, but with a book to promote, I logged in to write a post. A post I wrote all by myself, which makes me an outlier on the so-called professional social network these days. It's now full of AI-writing tools, letting Premium subscribers use AI to update their profile, reply to messages, and turn a couple of random sentences into a needy four-paragraph post that paints them in the best of lights. Heck, it even comes complete with hashtags.

> "I logged in to write a post. A post I wrote all by myself, which makes me an outlier on the social network"

Those tools surely explain the frequency at which some people post about their industry, their careers, their Tuesdays. And the sheer length of their diatribes. I'm not suggesting everyone is letting the AI write their whole posts – when I pasted a few with AI vibes into content checkers GPTZero and CopyLeaks, neither was certain the text was written by AI – but they're either getting help from artificial sources or going on week-long courses on how to write blandly.

What I can be certain about is that things are getting worse. Whether through the death of rival social networks, the rise of AI tools or the threats people feel to their jobs in these economically difficult times, LinkedIn is an increasingly busy place.

Now, there's nothing wrong with using AI to boost your LinkedIn output, make your job easier or sort other dull tasks. But it means a social network already full of self-promotion and industry-specific "thought leadership" is now overflowing with the stuff.

How fortunate that there's help to sift through it all. At the end of last year, LinkedIn also introduced an AI article-summarising tool. In short, it will "read" longer articles and spit out key points to save you time. So now machines are writing – if not entirely, at least partially – posts for other machines to read. Again, if not entirely, at least partially. Maybe we should all just log out and leave LinkedIn to its bots.

Does it matter that we're shifting away from human-written nonsense to equally pointless content written (and even read) by machines? Perhaps not on LinkedIn itself, as frankly it's always been full of people taking themselves and their think pieces too seriously, but if this is a sneak peek at the future of the wider internet, we're in trouble.

After all, the internet is already full of utter nonsense, as we humans are perfectly capable of writing pointless nonsense ourselves (let me make the joke for you: "Just like this column!"). Indeed, the fact that I can't tell which LinkedIn post is written using AI and which is an earnest professional networker reveals more about the latter and what we consider good business speak. It's inane and without meaning, making it perfect for replication by models that can't know the meaning of any of the words they assemble.

However, our existing generative AI models are largely trained using online text, and if AI increasingly generates that, digital words will no longer have any real meaning. They're already inaccurate: for example, Google showed off its latest Gemini AI model at its recent I/O conference; in a demo, it offered advice for when a manual film camera isn't working, including popping open the back – which of course would expose and ruin any photos.

> "Existing AI models are trained using online text, and if AI increasingly generates that, digital words will no longer have any real meaning"

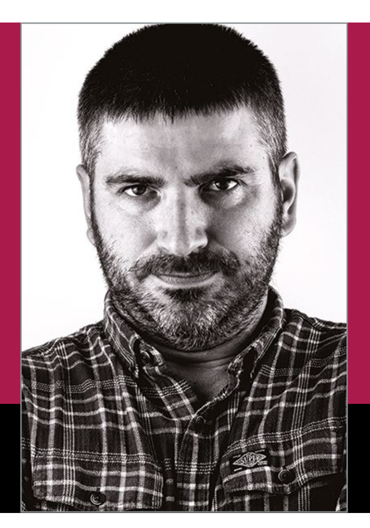
Perhaps it's a reflection of the tech-savvy people I know and have virtually connected with, but every other post on LinkedIn – written by AI or not – is about using AI at work, why it's the future of business, how to use it now, how *not* to use it now, and various nuggets of insight about what other people just don't get about the technology. So not only is AI writing and reading posts, it's also writing and reading them about itself. It's almost enough to make me nostalgic for the constant anger of Twitter/X or the unending consumerism of Instagram.

Thankfully, plenty of posts on LinkedIn are still related to redundancies or new roles, and that's the site I know and love. And if AI really is going to steal all our jobs, at least LinkedIn's generative tools can help us write our departure post, too.

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When you can't answer the call of duty

The phasing out of landlines is creating an emergency contact headache



Barry Collins is a former editor of *PC Pro*. He had a good night's sleep once in 2003. Reach him at all hours at barry@mediabc.co.uk @bazzacollins

What races through your mind when the phone rings at 3am in the morning? Well, forget that. What's keeping me awake at night is what's happening when the phone's not ringing.

I've reached that age where I have worries at both ends of the spectrum. I've got elderly parents, including a dad with his own parking space at the local A&E. And I've got a teenage daughter who's out clubbing until the early hours of the morning. If either of them is in a tight spot at 3am, I want to know about it.

Until about a year ago, they would have called the landline in an emergency. In fact, for the final few years of existence, the landline became known as the "nan phone", because the only (genuine) calls we ever received on the line were from my mum or my partner's mum. They were trained in the days when calls to mobiles cost 49p per minute and, like those people who hold out in caves because they think World War II hasn't ended, the nans refused to engage with mobiles.

Now they have no choice. We had fibre fitted a year ago and with the creaky old ADSL line went the landline. We could have taken a VoIP-based landline with the fibre provider, but there seemed little point. The nans would have to change their speed dials.

That, however, has created a problem. The landline's one salient feature was its reliability. Come what may – be it power cuts, broadband blackouts or an alien invasion – the landline just worked. If someone wanted us in an emergency, they would ring and ring until one of us groggily picked it up.

Now we don't have that. And soon nobody will, because the old copper landlines are being phased out, and even those who do retain one will be relying on VoIP technology that's only as reliable as their broadband connection. As editor Tim said when I pitched him the idea for this column: "Couldn't call my Dad on his landline last week as the VoIP system went wrong. So much simpler when we were all on copper lines, no software or IP involved."

> "The landline became known as the 'nan phone', because the only calls we ever received on the line were from my mum or my partner's mum"

Of course, the nans can always call the mobile, but that creates its own set of problems. Mobiles used to get switched off overnight in our house, because who wants to hear beeps and dinks all night? Not to mention the temptation of insomniac doomscrolling. How many times have you opened Facebook in the morning to find posts from people at 2am complaining they can't sleep? Yes; that's because you've just injected a hit of pure dopamine into your eyeballs by picking up your phone.

Now my smartphone comes to bed with me, albeit tightly controlled via the Do Not Disturb function. The phone will ring only for people selected as "favourite" contacts or for repeat callers – people who've rung my number more than once within 15 minutes. But what if my daughter's lost her phone and is trying to call from a friend's phone? Would the police or a hospital call twice in 15 minutes in an emergency? If neither of these scenarios has crossed your mind, I can only assume you've never had a daughter out clubbing until 5am, while you spend the night silently running through every unlikely mishap you can think of until you hear their key turn in the door.

> "How many times have you opened Facebook in the morning to find posts from people at 2am complaining they can't sleep?"

The death of the landline has removed the one almost fail-safe emergency contact in most homes, and I can't see an obvious substitute. We could get emergency pendant alarms for the elderly parents, but I suspected they would bristle at the idea and it's not really a direct replacement. We could buy dedicated burner phones, cheap mobiles with a pay-as-you-go SIM that sit permanently plugged in and are designated for emergency-only calls. But it seems a faff.

Curiously, the one alternative that has gained traction with our elderly parents is the Drop In function on Amazon Echo speakers. You can basically use these to automatically connect to a speaker in the other person's home, without them needing to pick up, potentially allowing you to speak with them if they've had a fall, or for them to reach us via the Echo Show on the bedside table. It's far from flawless, but there is something in the simplicity of being able to call a person by name that appeals to the older generation in a way that a smartphone most definitely does not.

In the meantime, if you've got any better emergency landline replacements, drop me an email. If you get a reply at 4.30am, that's because I'm fast awake waiting for a clubbing teenager to come home. Scrolling through my smartphone settings. Just in case.

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Readers' comments

Your views and feedback from email and the web

Osborne career effect

Adam Osborne (*see issue 357, p123*) was very influential in the direction my career took. I was a mechanical engineer in 1977, but also interested in electronics, and I wanted to get into microprocessors. I discovered some of his books on the shelves of the Modern Book Company near Paddington in London, for which he was joint author with Susanna Jacobson and Jerry Kane. His books gave brilliant explanations of how things worked, and were far superior to publications from Intel and Motorola.

I borrowed an Intel Development kit with a Hex keyboard and 7-segment display from my employer, and proceeded to teach myself assembly language programming, which led me to get involved with what we now term mechatronics. Sybex was involved in the publishing, and some of my Sybex books have nearly disintegrated from use. I have a lot to thank him for. **Chris Gay**



BELOW Dell's customer support failed to make one *PC Pro* reader smile



A question of support

I am a long-time reader of your magazine and have great faith in its recommendations. However, I wonder if it isn't time to expand the basis of your reviews to include a weighting for a supplier's customer support. This is an integral part of the product even if it's (hopefully) not needed often.

I recently purchased an Inspiron All-in-One 7720 to replace my existing 27 Dell AIO machine, which had given good service but was fading away. I had problems with the new system from the start, despite my extensive PC experience, but it just "wasn't right" and eventually locked. Without going into details, that was coming up to 12 months ago, and the latest contact was the fortieth – yes 40th.

The only support available is technical support, who have a very difficult job since they're given very limited ability to act, and contact with any other departments seems impossible – I have been given six different numbers to get to " the proper department" – but they all lead back to the same general switchboard.

While I did manage to finally get a refund, what a disgrace to what was once a proud company. During my professional career I bought many thousands of Dell PCs from what was then an effective company; no longer. So please consider adding in service reputation to your excellent reviews. **Steve Urwin**

Editor-in-chief Tim Danton replies: Thanks for your email, Steve, and I feel your pain. While we do incorporate customer feedback data (based on our annual survey) in our group tests' feature tables, I haven't found a way to do so in individual reviews without muddying the design. It's actually quite difficult data to convey in a small space, and there's a lot of information to get across with each review! This year's voting is now open, so I ask everyone to take part in this vital survey at tinyurl.com/pcproawards24.

Star letter

Smart grid, silly investment?

Your smart home grid article (*see issue 357, p26*) was fascinating and an excellent example of the enjoyment of technology for its own sake. But the "savings" reported don't consider the upfront investment and the risks.

I recently had a £9K quote for a solar and battery system on my east/west- facing roof. It was estimated to save £15.5K energy, a net of £6.5K, after 25 years, which is the predicted life of the panels. This quote didn't include the cost of buying and fitting a new inverter and battery after 12 years, which would be £3K at today's prices. That leaves me with a net gain of £3.5K after 25 years. This quote assumed I used their solar+battery tariff for 25 years and that this offered the same rate all that time, which seems unlikely for a "beta" tariff that didn't exist mere months ago.

Households with a south-facing roof may see a better return than my quote. Rob's system and agile tariff may also produce bigger savings than my quote, but this assumes the agile tariff is around for 25 years and the UK is still on speaking terms with the Chinese inverter company, which hosts his cloud data for free.

Financial advisers urge caution if you need to borrow to purchase a solar system, or if you have other loans that could be paid off. If I invested that £9K for 25 years I would have £31K at 5% interest or £15K at 2%. So solar plus battery reflects a risky low return that one could reliably achieve with a secure bank deposit.

Imagine that water worked this way. It was cheap in the wet winter months and very expensive in the summer drought. Rich people with large gardens could buy a water tank reservoir that they filled with rainwater or from the "grid" when cheap. Then in summer, they draw down on their private supply. Instead, we have enormous reservoirs paid for collectively and that offer fixed-price reliable water all year round for all people.

As we shift towards electric cars and heat pumps, when everyone is charging their cars and heating their water tanks at the "cheap" times, they won't be quite so cheap any more. Suppose the economics of battery storage to "flatten the curve" improved. Instead of householders buying expensive, potentially flammable and short-lived lithium batteries, the energy companies or big business filled empty offices and factory buildings with them. Your energy company would then be able to offer you a cheaper fixed rate all day long, and household batteries would seem as weird an idea as household water reservoirs. **Colin Harkness**

Features editor Barry Collins replies: You make several good points, Colin, and you're absolutely right not to regard installing solar panels as a get-rich-quick scheme.

The piece was aiming to illustrate the savings you could make if – like millions of people across the country – you've already got panels and batteries installed, but we're not claiming it's the best possible return you could get on a £10,000 upfront investment.

There's also the environmental upside. If you're maximising the efficiency of your panels and using the grid less, that's good for all of us. As would "flattening the curve" in the long term, reducing our dependency on fossil fuels and nuclear energy.

This month's star letter writer wins a Cherry KC 200 MX mechanical keyboard, worth £80, recipient of a five-star review and a *PC Pro* Recommended award. Email letters@pcpro.co.uk



Power failure

I was entertained to see that you used a photo of Sizewell A nuclear power station to illustrate a caption of coal and gas stations still being used at peak times (*see issue 357, p29*). The white containment dome of Sizewell B in the background really should have given you a clue! **Alex Gray**

Editor-in-chief Tim Danton replies: I wonder if I can brazen this out as a deliberate test for our readers to see if they're concentrating? No, probably not. Thanks for writing in, Alex. We'll pay more attention to such things in the future!

Echo howl

I sympathise with Barry Collins' howl of protest (*see issue 357, p22*) at the current vogue for subscription models for almost everything. However, I think manufacturers have created a problem of an entirely new type – and one they need to solve urgently.

Take the Amazon Echo ecosystem. I currently have three: two Echo Dot 5s and an Echo 4. These three devices serve my needs admirably, so I can't see why I would ever buy another one. To put it bluntly, I no longer contribute to Amazon's cash flow. Yet Amazon continues to support my use of Echos through regular software updates, database maintenance and speech processing. And since I always bought the hardware when it was discounted, that lifetime support is provided against a total outlay of about £75.

The "lifetime support" promise was essentially a loss leader to draw buyers in, but manufacturers ignore the word "loss" in that phrase at their peril. They need a way to take out of the equation. And since the entire population is now habituated to the current "free" model, Barry's howl will pale into insignificance beside the 157 million Echo users worldwide baying at the moon, whatever remedy Amazon chooses. **Robin Jones**

CORRECTIONS & AMPLIFICATIONS

In our review of the Lenovo ThinkVision 27 3D monitor (*see issue 357, p48*), we incorrectly stated that the 3D effects only worked over USB-C. It will actually work over the HDMI or DisplayPort connections too, but you need to add a second connection via the monitor's primary USB-C port (not the second USB-C port).

Readers' poll

What do you use your NAS for?



If you remember the microwave ad campaign "I use mine to do reheating", then you may understand why we started humming that tune while reciting "I use mine to do backupping" as we analysed this month's poll responses. Almost everyone who answered used their NAS for backups, and roughly half also streamed video (usually using Plex). File sharing and CCTV were also popular, but others used them to store VMs and for home automation.

For some reason, lots of people called Paul responded this month, starting with Paul Bamberger, who owns a Synology NAS for home use. "It acts as a file server, media library, CCTV server and backup for home devices," he said, ticking all our main boxes. "I've had it a long time (2011) and I'm pondering if I replace it or shift to cloud storage and services, but a local backup of my DAW (12TB+ of files) still feels like a better plan on the home network."

Paul Blair is another happy Synology customer, with his DS423 "the centralised backup location across the devices, Plex server, family share drive, home automation. It's on when everything else is switched off [and] when the internet is down."

Paul Ockenden says that he has "rationalised" his several NAS drives down to a single QNAP that he uses "to host a few VMs and Docker things. But as for storage/backup, most of that has now been migrated to (redundant) cloud services. I no longer actually rely on my NAS now, and should probably retire it to reduce my electricity baseload."

And our final Paul isn't convinced that buying a NAS is worth the expense. "I use an external SSD drive to back up files every few months," said Paul Rohrbaugh. If you're still in two minds, there are two relevant articles this month. First, our group test of NAS drives on p78, and then Jon Honeyball's backup treatise from p110. Our thanks to everyone who took part in the poll.

"Used for main storage backup, nothing more, nothing less. All the apps it comes with are just bloatware to me."
Lincolnshire Rebel @LNSRBL23

"Data backup. Plex media server. Thinking of updating to a newer machine that will allow me to run Roon."
Sussexwalkabout @SussexWalkabout

"Used remotely to back up a Windows server. Works a treat."
Gary Partis

"[My old NAS has] been replaced by a mix of Dropbox, Google Drive, iCloud and streaming movies and music."
Iestyn Lloyd-Wilkins

Join the debate

Join the growing *PC Pro* community on Facebook at facebook.com/pcpro

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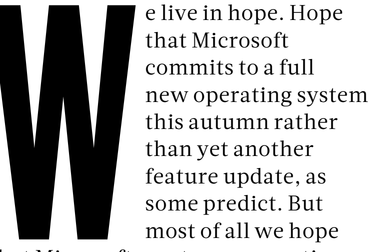


WINDOWS 12 WHAT WE WANT

WITH THE NEXT VERSION OF WINDOWS LIKELY TO LAND THIS AUTUMN, WE ASKED OUR CONTRIBUTORS WHAT NEW FEATURES THEY WANTED – AND WHAT OLD FEATURES THEY'D LIKE TO SEE THE BACK OF

CONTRIBUTORS: Steve Cassidy, Barry Collins, Tim Danton, Darien Graham-Smith, Lee Grant, Jon Honeyball, Nik Rawlinson, Davey Winder





We live in hope. Hope that Microsoft commits to a full new operating system this autumn rather than yet another feature update, as some predict. But most of all we hope that Microsoft creates an operating system that solves our frustrations, stops hitting us with ads and opens up new possibilities.

To find out what people wanted from the next iteration of Windows, we asked around. Lee Grant asked his customers. We put out messages on Facebook, Discord and X to discover what our readers desired, and have scattered those suggestions throughout this feature. And we asked our own contributors to share their thoughts.

We've broken the suggestions into a loose collection of headings to make them easier to navigate – easy navigation, who'd have thought people wanted that? – but really this is a collective howl of frustration and want.

Will Microsoft deliver? We continue to live in hope.

USABILITY & INTERFACE

PROMOTE WINDOWS GESTURES

I used to cry myself to sleep at night because I thought Microsoft had removed the "shake to minimise" gesture, where you grab a title window, shake it and all the other apps minimise to the desktop. What I didn't realise is that it's merely hidden the option away: search for "Multi-tasking settings" and you'll see it there, bold as brass. And that's my problem with Windows gestures. They're genuine time-savers, but

> "FINALLY UPDATE ALL THE OLD CONTROL PANEL/DEVICE MANAGER/DRIVE MANAGER TOOLS TO THE MODERN APPEARANCE."
> RYAN THOMAS @RYFISH

Microsoft has done such an awful job of promoting them that all the onus is on us, users, to seek them out. Whether people are using mice or touchpads, Microsoft needs to push gestures to the fore in Windows 12. TD

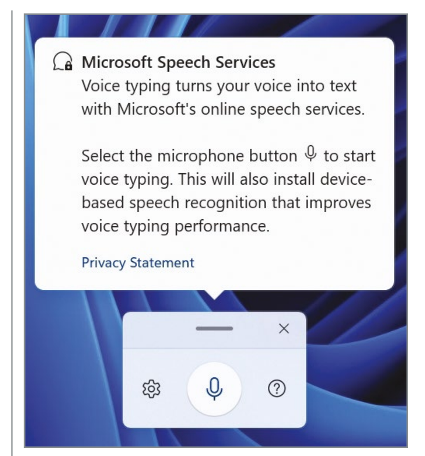
MAC LEVELS OF COHESION

One of the great weapons that Apple has is that everything works, although it obviously has the advantage of controlling both hardware and software. Microsoft has attempted to create a more cohesive "experience" for its customers across Android, iOS and Windows through apps on phones and tablets and its own Phone Link system built into Windows 11. The trouble is that both are afterthoughts. With Windows 12, it has the opportunity to steal ideas from – sorry, be inspired by – Honor and Samsung that detect if a tablet or phone is nearby and then work out ways to swap files between them, or turn them into secondary screens. TD

A PROPER TOUCH INTERFACE

If there's one thing writing this month's feature on handheld PCs (*see p34*) has made thunderously obvious, it's that the Windows 11 desktop isn't a touch interface. Trying to donk tiny icons on a 7in screen is like trying to thread a needle with a climbing rope. Consequently, manufacturers resort to their own overlays to try to make the OS usable.

I know we've been here before with Windows 8, but Windows really does need both touch and non-touch interfaces, with touch scaling as required to the size of the device. It shouldn't be beyond the wit of Microsoft to pull this off. BC



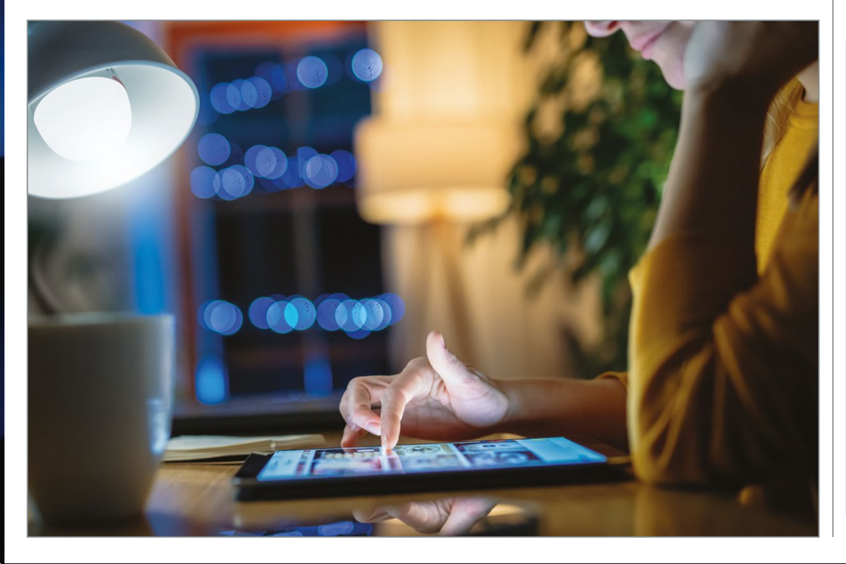
ABOVE Windows' voice typing capabilities should not require calling on the cloud

BETTER SUPPORT FOR WINDOWS ITSELF

Isn't it a little strange that Microsoft has effectively outsourced support of its operating system to us? That is, the community of "techies" that have to handle queries from friends and family in a Colombo-style "one last thing" before we head out the door? Perhaps Copilot for Windows 12 will take some of the load, but judging from the absolute piffle that appears most times I've ever used Windows' built-in help, I somehow doubt it. TD

VOICE TYPING THAT DOESN'T RELY ON AZURE

Of course we trust Microsoft with our data; that's not why we want to move voice typing from the cloud to our



BELOW A proper touch interface for Windows is long overdue

> "SOMETHING THAT DOESN'T SCREW UP MY HARDWARE/SOFTWARE AT EVERY UPDATE. AN END TO OFFICE 365 AND ITS EXORBITANT MONTHLY CHARGES. A WAY OF COMPLETELY REMOVING EDGE AND ITS NAGS."
> GORDON JACKSON, FACEBOOK





RIGHT **Teams could help users a lot more when a business meeting is interrupted**

device. This is more about being able to dictate whenever and wherever we are, even if we're offline.

Products such as Dragon Dictate built names for themselves by handling offline dictation in the pre-cloud era, so it is possible. Granted, Dragon Dictate Professional also benefits from cloud processing and AI in its current form – and cloud processing, whoever the provider, should deliver accurate results that only ever improve as the back end encounters more diverse accents and a wider vocabulary when new users sign up.

It's also true that offline dictation products are set in aspic when they ship, and while they're unlikely to evolve at the speed of a cloud-native rival, they can and do get more accurate if the user is prepared to correct errors when they crop up. Moreover, third-party offline dictation was already impressive ten years ago, and processors have become faster and much more capable in the interim. Why not use that potential? NR

AI

CREATE AI SHORTCUTS

Last year Microsoft announced the Copilot key, which is already starting to appear on new laptops (I expect to see it on keyboards later this year). Which is all very well, but it ignores the hundreds of millions of Windows 11 computers that will never have such a key – and it's also rather basic. Instead, I'd like to see Microsoft take a leaf out of Logitech's book.

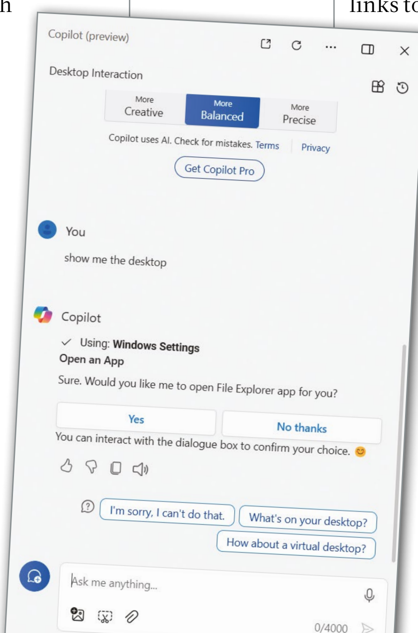
Turn to p75 and you'll see how the company is using shortcut buttons so that its customers can better access AI features. Now, as a Logitech keyboard or mouse user, I can call up ChatGPT at a moment's notice or set a macro-style-stream of AI-based commands flowing. So come on Microsoft, why not do something similar? After all, you know exactly what keyboards and mice people are using. TD

DESKTOP AI

It's a good bet that Windows 12 will be loaded with new AI features; my hope is that they're not limited to fripperies such as automatically changing your desktop wallpaper or enhancing your photos in Paint. I want an AI that watches what I'm doing on screen and pops up contextual tools and controls to help me get where I'm going. Imagine a Start menu that could actually make helpful suggestions, based on what you're currently in the middle of – or an Explorer view that offered quick links to useful locations, based on the programs you've been using and the files you've been working with.

I don't think this is an unrealistic vision. Microsoft already ought to have petabytes of data about people's workflows – and if it doesn't, it has the infrastructure in place to very quickly collect it. The question is, does it really want to help users get things done, or is the fixation on AI actually all about marketing? DGS

> "NO ADVERTS/NAGGING. OR AT LEAST THE ABILITY TO PAY FOR IT SO THAT ADS CAN BE TURNED OFF IF YOU FIND THEM ANNOYING. THE ABILITY TO DELAY FORCED UPDATES IS STILL IMPORTANT, DUE TO CRASHES THAT THEY CAUSE."
>
> DAVID WILSON @DAVIDWILSONTW



BELOW **It would be nice to be able to switch from Copilot to an alternative AI**

FORENSIC-GRADE WEB HISTORY

It's about time we admitted that the History menu in most modern browsers should itself be consigned to history. It's time for a rewrite, with more intelligence – artificial intelligence, perhaps – in the categorisation system. I want to see sites that redirect my browser too much, or have domain names that give no clue as to the country or company presenting them. What we need now from Windows are the tools to help us run our lives within our computers. SC

OPTION TO TURN OFF COPILOT (AND EDGE)

I'd like the ability to switch Copilot for an alternative AI. Microsoft invested heavily in OpenAI, so it's understandable that it wants to reap the rewards, and if that means smarter problem solving in Windows itself, great. But beyond that, how about allowing us to incorporate the LLM of our choice?

While I'm at it, I'd like Microsoft to stop thrusting Edge into my face. What happened to letting the user pick from a range on first boot? If that's going too far, then at least make it easier to opt for an alternative for every document type it can handle, rather than having us switch supplementary protocols and formats by hand.

And face it, Microsoft, your strategy isn't working. At the time of writing, Statcounter puts Edge's market share at 5%. Clearly I'm not the only one who turns on, logs in and opts out. Making the Chromium engine part of Windows is fair enough, so apps can call on it when they need to embed web views. But Edge is a waste of space on most people's machines; an irritation that pops up when we least want it.

> "POWERTOYS RUN, FANCYZONES AND TEXT EXTRACTOR MOVED INTO STANDARD FEATURES FROM THE POWERTOYS ADD-ON, THEY'RE EXCELLENT."
> EMPTYCALORIES, DISCORD

I'm not holding my breath on either count. Browser dominance is a race worth winning and, with Microsoft adding dedicated Copilot keys to its standard keyboard design, I reckon native support for rival LLMs is even less likely than Edge being edged out. NR

MODERN WORKING

CREATE A HOME/WORK DIVIDE

With so many people now using the same hardware for both work and pleasure, surely it's time for Microsoft to create a split-personality option to match? Sure, we have "Focus sessions" where you can set a timer and switch off, say, flashing taskbar apps, but I want a true distraction-free environment. It could be a virtual desktop that only displays productivity apps of my choosing, which I need to actively exit if I want to check Facebook. The only thing I ask: this should always be under user control, not some whip-wielding manager. TD

TEAM-WORTHY TEAMS

WFH is a big deal: not because it's innovative (Skype is 21 years old this year, by the way) but because it makes people nervous and obliges them to perform in front of colleagues. For some, this is like being invited to perform on *Britain's Got Talent*; for others, it's the most painful, drawn-out torture imaginable. So come on Microsoft, take some of the strain.

One example: stop making Teams so bloated that it drains all your computer's resources. Another: help your users when a business meeting is interrupted. Having to cope when Teams won't make a connection is, for some people, a major source of workspace stress. An AI that can present the same information as the old command-line utility PathPing in a reasonably simple interface – to show where your call data has been interrupted and by whom – would reduce blood pressure in uptight businesses all over the world. SC

WHAT PC PRO READERS WANT: X

"An operating system that's seen and controlled by the user, not by Microsoft."
Mike Henson @MikeHenson

"Finally update all the old Control Panel/Device Manager/Drive Manager tools to the modern appearance."
Ryan Thomas @RyFish

"Better security (perhaps a lockdown mode for home users)"
Richard Hough @RikHough

"No ads! Also make Windows Update less odious. I have no plans to change from macOS, iPadOS and Linux, but it would be nice to feel that Windows won't be painful if I need it."
Henry @projiuk

"A Win 7-style UI, no ads and telemetry."
Michael Dear, @maxsendq

"Option for a clean, no-advert interface as Linux has been for 30-plus years. Sudo enabled by default with developer options. Stop pushing awful Edge."
mrg9999 @mrg9999

"VLC-like media player that actually plays everything. Scanner interface I can explain to my mum over the phone. Easy remote assistance."
Marcin Gorecki @ marcinmgorecki

"Less mess. I want a tidy desktop, a simple program launcher, and only one user in Windows Explorer, which I can adapt to my own wants and needs. 98 SE was so much easier to use, now files are everywhere."
Grumpy Girdle @TanyaAGT

"A proper file history that isn't a glorified backup but a proper file versioning system with past versions listed in the versions/history tab of the file properties dialog."
John O'Connell @endurium

"No breaking muscle memory. Taskbar on all four sides as per 10."
PJ Bryant @pjbryant

"Make the taskbar move again. I want it on the side, not the bottom."
Crispin Cowan @CrispinCowan0

"Have a clear pricing/ad strategy. Eg: Enterprise L (no ads, £per seat); Business L (no ads, £per licence, transferable); Home L (no ads, £per licence, transferable); Home Starter L (ads, but upgradable to no ads, transferable; OEM Licence (ads, but upgradable to no ads, not transferable)."
Mike Gannon @Scrufter

> "I VERY MUCH WANT THE AI FUNCTIONS TO HAVE A GLOBAL ON/OFF SWITCH SO I CAN SWITCH IT ALL OFF IF I WANT."
> CHRISTOPHER BROOKES, FACEBOOK

BELOW More support for working from home, please

BETTER WEBCAM SOFTWARE

We're finally reaching the point where webcams built into laptops produce half-decent results, so now is the time for Microsoft to provide software to match.

I've come to genuinely appreciate the Studio Effects that add blur to backgrounds – so long as the processor includes an NPU to take advantage – but that's about the only change we've seen to this very basic app for years. TD

WEB CONFERENCE SKILLS

Together with better webcam software (*see above*), I want to see clever Zoom/Teams/Webex integration. I have a funny plastic box here that lets you run the conversation in the role of ringmaster, by way of half a dozen single-purpose plastic buttons and a Bluetooth radio. The fact that this reduces my stress levels while on calls shows just how bleak and unsupportive both Windows and the services themselves are. I'd like Windows 12 to have a ringmaster smartphone app, with some simple tools for muting or handing over or setting some participants to voice-only mode, all aimed at making the "call concierge" role less of a sweaty neck job. SC

ARCHITECTURE & PERFORMANCE

COMMIT TO ARM

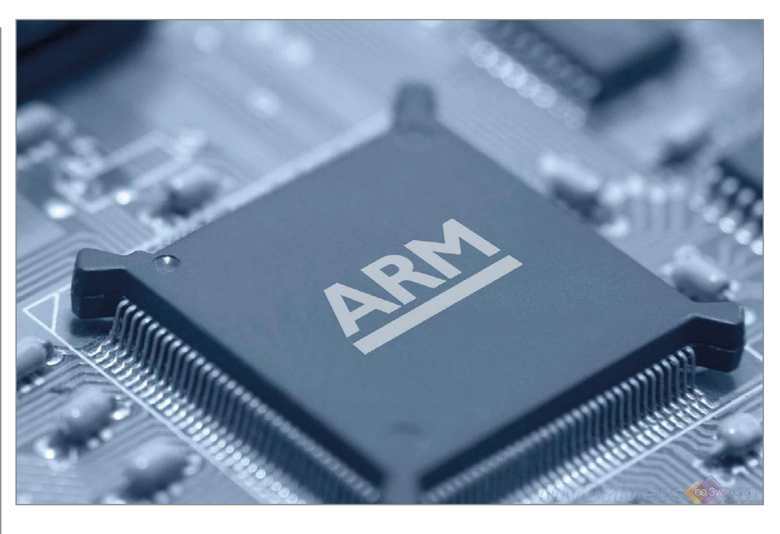
We all know that Apple has the advantage over Microsoft due to its total control over hardware and software, and nowhere has this been more obvious than through its



switch to ARM. No kowtowing to partners: boom, we've changed, get used to it. And the results have been phenomenal in terms of both power and battery life.

In the meantime, Microsoft has publicly experimented and fumbled, with Windows RT followed by Windows on Arm. Even as we went to press, it announced that the first wave of its AI-enhanced Copilot+PCs would launch exclusively on the ARM-based Qualcomm Snapdragon X Elite chip. The trouble is, Microsoft has history of deprecating its ARM-based OSes, which doesn't exactly inspire confidence among punters.

So here's my request for Windows 12. Make it absolutely clear how ARM fits in with your strategy. Commit to a decade of support. Extol the benefits, and don't worry about what AMD or Intel might be whispering behind closed doors. Commit, damn it. TD



ABOVE **Take a leaf out of Apple's book when it comes to ARM and commit**

A 21ST-CENTURY FILE SYSTEM

It's been a long time since Windows had a proper update to its file system, and frankly we're overdue. Linux users get to enjoy ext4 and ZFS, with powerful journalling and snapshot capabilities built in, while I'm still stuck here in Windows trying to work out which process is blocking me from deleting the file on my desktop. A mature OS needs a robust and versatile file system – and while we're at it, can we also sort out the directory structure? I very much don't need every application I install to spatter its components across 50 different folders and Registry locations. The Mac has been managing this much more neatly for more than 20 years, with applications that mostly install into a single directory; Microsoft really has no excuse for not having caught up. DGS

> "INCLUDE SOMETHING SO AWFUL IT FINALLY CONVINCES ME TO SWITCH TO LINUX COMPLETELY."
> MURGATROYD @MURGATROYD99

FULLY SANDBOXED APPLICATIONS

Windows RT was mostly a terrible idea, but it got one thing absolutely right: every RT app ran in its own individual sandbox. The same applies to Windows Store apps today, but it's high time the principle were extended to all desktop apps. This is hardly a radical idea: businesses operate containerised servers and virtual desktops as a matter of course. Microsoft's own Xbox consoles run games in virtual machines that can be instantly suspended and managed from the main dashboard. As well as closing off any number of vulnerabilities, moving our applications into VMs would give us the power to easily migrate between computers and Windows versions, and to throttle any apps that were eating up resources – finally putting us in proper control of our own systems. DGS

SMART PERFORMANCE

More than anything else, I want Windows 12 to perform. I want the quintessential greased-rat-out-of-a-wet-drainpipe experience that has

WHAT LEE GRANT'S CUSTOMERS WANT FROM WINDOWS 12

Lee Grant runs a repair shop in Kirkheaton with his wife Alison, as regular readers of our Real World Computing section will know (*see p113*). As such, they kindly give him a constant stream of feedback about what they want to see in Windows 12. Or, to put it another way, what they hate about Windows 10 and 11.

Here, Lee has grouped all this constructive feedback into four key categories. We suspect that many of his customers' responses will be familiar to anyone who has needed to help out a friend or relative with a problematic PC.

WINDOWS UPDATES

"Windows Updates are great," said no-one ever. Now brace yourself for a shock, but most users complain about the never-ending barrage of updates that seem to plague every Windows 11 restart – it's not just you. Kicking Windows Updates is a cheap shot, and users understand that they're a necessity with a modern OS, but if Windows 12 is to put a smile on users' faces, start with the top two things on the wishlist.

First, bring back the option to exclude certain updates. Second, make it simpler to prevent Windows from updating the drivers for specific (or all) components. It's possible to manage both through a complex combination of Registry hacks and goat sacrifices, but this is hardly user-friendly. Microsoft can score some simple Brownie points by giving Windows 12 users much more control over their updates.



ABOVE **OneDrive has a lot going for it, but we don't need it pushed down our throats**

ONEDRIVE

Microsoft is trying to force-feed OneDrive to us like we're geese in a foie gras factory. There's a lot to love about Microsoft's cloud offering, but only if you know what it does. Customers feel tricked when an innocent mis-click uploads files from their machine, and experience a heart-attack moment when they find their Pictures folder is empty. Microsoft makes reversing this process cryptically non-intuitive as OneDrive is its Hotel California (you can download any time you like, but you can never leave).

To make things worse, especially for 5GB freebie users, OneDrive doesn't look ahead to calculate if there's enough free capacity, only working out that it's full when nothing else can be pushed through the door. Logically, this is as sensible as only realising that you can't eat another slice of pizza once you've been sick on the floor.

This is doubly annoying for Outlook.com users who don't realise that OneDrive relates to their mailbox capacity, so once OneDrive is full all their incoming email is bounced back. Genius! Users tell me they would like the very simple option of an offline Windows experience, unconnected to the cloud, with no nagging. However, it's more likely that Nigel Farage will become the next James Bond than Microsoft introducing this option into Windows 12.

been missing for years. Windows 10 and 11 were quick because of the rise of SSDs, not because of optimised coding. How do I know? Sitting to my left is a Windows 10 laptop sporting an AMD A4 chip with 4GB of RAM and a 64GB eMMC. If I switch it on now, it may have booted by Christmas. I want Windows 12 to fly on these sorts of low-powered machines by using smart optimisation and hardware compensation.

Windows 12 should have a select core of features and only download guff on user demand. Why does this A4 have the Mixed Reality Portal app auto-installed when the hardware is clearly inadequate? Why does Windows install with multiple Xbox apps when most users don't own an Xbox?

Younger readers won't remember a time when Windows was quick, but to my right is an 18-year-old XP machine with a single-core CPU, 512MB RAM and an 80GB PATA drive, and it flies. Admittedly, it's almost useless, but it's a reminder that users used to manage with much less. Microsoft needs a *Rocky 3*-like montage to thrash Windows 12 until it re-emerges, lean and oiled, looking like a genuine contender. LG

> "A MODERN-LOOKING WINDOWS WITH A BREAK FROM ALL THE LEGACY STUFF BUT STILL LOOKING VERY WINDOWS-LIKE."
> STEPHEN CORNISH, FACEBOOK

BELOW Why install Xbox apps when most users don't own an Xbox?

AVOID THE ONEDRIVE LOCK IN

With Windows 12, it's likely we'll see tighter integration between Windows and Office, with the clear push to moving to one subscription for both. Microsoft also pushes users very hard to use OneDrive. Depending on your installation, OneDrive is made the default storage space for Windows, with a redirect of Desktop and document folders into a OneDrive tree rather than the more usual local storage space.

This is especially notable within Office itself, where File/SaveAs will take you to a OneDrive storage window first. From this you can choose to go to "Local Files" if you want to use a local drive or a local network store such as a NAS. At least on Office for Windows, you can override this setting and force Local Files as the default. However, this isn't possible on Office for Mac.

I would like to see Windows 12 take a more open approach to storage, and to stop trying to force OneDrive on users, both within Windows itself and inside Office. There's nothing wrong with OneDrive and it's a good default for many users. But it isn't necessarily the best fit for all – and getting out of the default configuration can be tiresome. JH

REPAIR & SUPPORT

PROPER REPAIR/REINSTALL OPTIONS

I'd love to see a proper diagnosis and repair suite for Windows 12. There are too many times when the only repair option for Windows is to erase and start over. I've spent years bashing DISM strings into command windows, and despite having a workshop full of tools and tricks, too often I'm forced to concede and admit defeat.

Windows is great at resolving little "coughs" that occur from time to time, but when a major mishap brings out the BSODs it loses its mind. System Restore points go missing and update rollbacks fail, declaring, "We've encountered a problem". It really isn't good enough.

In extreme cases when a reset is required, Windows 12 users would benefit from an Internet Recovery

THE UI

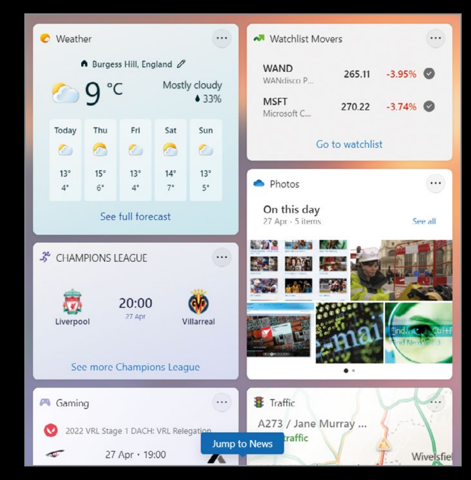
Where do I begin? To most of my customers, Windows 11 is Windows 10 with a bad facelift. Aesthetically, it's fine, but its functionality drives my customers insane. Want a Desktop shortcut for your favourite Start menu app? It will take you a while to work out how to do it. Need that quick right-click context option? Tough! It's been hidden behind "Show More Options".

But that's not as bad as Widgets. Customer muscle memory means that they're still clicking the bottom left-hand corner, which launches Widgets, displaying the very best Bing-powered clickbait that someone is desperate to make money from.

A favourite shortcut recently removed without user permission was the "show desktop" slice at the right-hand side of the taskbar. This is now the home for Copilot, which is Microsoft's version of Call My Bluff. When I asked Copilot to "show me the desktop" it replied: "'Sure. Would you like me to open File Explorer app for you?" My customers will be thrilled that their Windows 12 laptops will possess a dedicated Copilot key in order to be misguided at the push of a button.

For long-term users, the slow eradication of the Control Panel has been particularly annoying, especially in the Devices and Printers department, but as some Windows features seem to merge, others are becoming more disparate. Some of my customers who have additional visual requirements hope that Windows 12 will bring an intuitive and cohesive experience to simple tweaks such as text resizing and contrast manipulation.

Customers groan at the visual disconnects between the OS and apps. For example, increasing the default text in Windows doesn't automatically adjust the same in Office. A blind customer recently told me he's never been able to efficiently use Windows without third-party accessibility software. I've been told that Microsoft has made successful strides in improving the accessibility of Windows, but Windows 12 needs to bring better tools into the core product as part of the standard development and not as a bolt-on.



ABOVE Widgets: Bing-powered clickbait that someone is desperate to make money from

WINDOWS S MODE

What do you think the "S" in Windows S mode represents? Safety? Security? Well, to be frank with you, "s**t" is the most common one I hear. For the uninitiated, Windows S is a laughable version of the operating system that only installs apps from the Microsoft Store – and my customers have repeatedly told me they hate it.

Step into a customer's shoes for a moment. You unbox your new laptop, go through the setup and feel pleased with your new purchase, until that downloaded driver refuses to install. The printer software also fails, just like the accounting package for your side-hustle. Little wonder that the next time I see the customer, they're shouting at me for selling a faulty machine.

The awareness of S mode is so appallingly low that average users don't know what it is or how to ping the free upgrade to Home. From what my customers have (sometimes forcefully) suggested is that Windows 12 S should be an opt-in downgrade (definitely a downgrade) and not the default, which makes much more sense.



mechanism like Apple has utilised for many years. In the past, a procedure called Repair Install was possible on non-booting machines, which could get systems off their knees and stop them crying. Repair Installs are possible in Windows 11, but only if the machine starts correctly. Windows 12 needs to break this Catch-22 madness. LG

WINDOWS 12 LTS FOR ALL

Microsoft does release LTS (or long-term service) versions of Windows 11, but only Enterprise licence customers have access to them. What I'd like to see is something more akin to Ubuntu's release schedule, with an LTS available to all every two years, and six-monthly updates for those that want them.

Stability is everything for a day-to-day working PC. I'd be happy if Microsoft nailed down LTS versions for three years and kept the feature updates on an annual cycle, so that there's less disruption all round. A guarantee that nothing serious is going to change (and possibly break) for three years would give me much more confidence to upgrade to Windows 12. BC

PROPER BACKUP AND SYSTEM TRANSFERS

Backup is easy on a Mac: give access to a drive, set it up as Time Machine, and then a rolling, almost real-time backup is done of the whole computer. All your files, all the system settings. Recovery is simple, either for a file or folder, or for a whole machine. Transferring yourself from one computer to a new one is a matter of a few mouse clicks.

It's high time that Windows 12 supported a similar solution, especially for the home, SOHO and small business user. It shouldn't rely on third-party apps to make this work, and it's a significant issue with all versions of Windows up to Windows 11.

I accept that full machine recovery, especially from one vendor to another, can be fraught with driver issues, plug-and-play storms and all sorts of unpleasantness. But this is 2024 and I'm tired of the excuses.

And while we are at it, it should be possible to boot any Windows machine directly from the internet, too. This can bring down the entire operating system and install it for you.

ABOVE Wouldn't it be nice to set and forget backups as you can in macOS?

"HOW ABOUT STOP POINTLESSLY MOVING THINGS LIKE THE MENU BAR OR SIGN-OUT OPTIONS? I BET THEY DIDN'T CALC THE TIME THAT HAS WASTED BUSINESSES. BASICALLY WIN 10/11 IS GOOD ENOUGH."
NEILW @LAWNDART16GE

"SOMETHING LIKE THE OLD WINDOWS 98 PLUS PACK THEMES. WINDOWS IS SO FRIGHTFULLY DULL. REALLY, REALLY SLICK AND BEAUTIFULLY DESIGNED OPTIONS FOR SPRUCING IT UP. (WITH BORING STILL AVAILABLE OF COURSE.)"
GAVINHALL, DISCORD

Again, this is incredibly easy on a Mac. It's about time that Windows 12 supported something similar. JH

CLASS-LEADING REMOTE ACCESS AND SETUP

The remote-access market is vast, with over 30 products vying for attention. Some of them are gold-plated, super expensive corporate support tools; others will take money from ransomware pirates, giving them an easy route into the victim's computers and data. The time has come to thin out this marketplace, both because of the – ahem – spread of moralities in suppliers and because the operating system is the right place to conquer the twin issues of traversing the infrastructure and securing the little roaming device that inevitably is the one needing the support. It's about time that having a Microsoft ID actually delivered some benefit to the user, and this is the right job to realise that dream. SC

WHAT *PC PRO* READERS WANT: FACEBOOK

"To quote Steve Jobs from Macworld 2001: 'Performance, performance, performance.' Currently on Windows 11 23H2, and it feels/acts slower than Windows 10."
Michael Oglesby

"Keep it free."
Duncan Wakefield

"Remove the artificial restriction on perfectly good hardware that stopped Win11 upgrades to try to force new hardware purchases... oh, did I say that out loud? An app store that app devs actually want to put their apps in and make it the one-stop shop for apps (not going to happen, I know). Stop asking me if I want an Office 365 subscription or if I want to change browser settings to Edge after every update."
Mike Webster

"More of the same – continuing improvements to stability and performance (quiet at the back!) as we've seen going through 10 into 11. More of the accessories moved into the Windows Store. More emphasis on the snapping features and intelligent use of multiple monitors. The AI stuff is a work in progress, but I'm excited for the intelligent searching that's being rumoured, sounds like the old Timeline done much better, which could be a real boon for productivity."
Geoff Campbell

"The ability to still log in as a local user rather than with a Microsoft account. Tabbed File Explorer and other apps (though I happily use Stardock Groupy for that)."
Ben Skip Bruce

"Automated AI driven system repair/recovery tools."
Tosh Malone

"A Linux system with a Windows front end and compatibility with all software."
Jeff Pendlebury



> "Unlike Win11, how about working on my not just quite high enough spec PC hardware!"
> Crusoe @Hobson1999

BUSINESS & SECURITY

MORE TIMELY SECURITY UPDATES

There's no denying that Windows is a code behemoth, and that's a bad thing from a security perspective. I'm not talking about more code meaning more potential for vulnerabilities, but rather the way that code is structured makes implementing security updates a bigger pain than it should be.

Instead of the Windows system living on just one writable partition, it would be great if Windows 12 adopted a state-separated approach. This modular design, which rumours suggest is being developed as "CorePC" by Microsoft, would have multiple secure partitions with encrypted user data accessible after logging in. Importantly, core system data and user data would no longer reside on the same partition.

Moving system files required for boot-up to a separate read-only partition that can't be modified by apps or users is an obvious security advantage. Perhaps less obvious, but equally important, is that by separating OS, apps and data you can have much faster and more stable updates.

While the idea of Patch Tuesday – with all security updates available on a given date to allow for better planning – is a good one, it could remain but be complemented with rolling security updates for those users who want them. Because only the applicable partition is updated, this means that rolling back the system to a pre-updated and stable state should be much faster and easier, negating much of the reason for Patch Tuesday in the first place. DW

BUILT-IN PROTECTION AGAINST RANSOMWARE ATTACKS

Here, I'm thinking about smaller businesses, not well-supported enterprises. I'm thinking about a mix of cloud backup and cloud sandboxing, so the bad guys can't stop you working.

Plenty of enterprise backup toolkits include the ability to keep a cloud-resident version of your laptop's sandbox VM workspace in sync with the roaming version. This achieves practical protection against ransomware, but requires a cool head when populating the device with logins and passwords; a competent ransom attacker will gain control of the account used by the innocent worker, so the continuously updated VM must be logged in and active under another user and password combination.

The remediation process after the infection and ransom process must be simple. Sandboxing ought to mean that the "survivor" twin of the VMs that were attacked is just as runnable once re-downloaded to the laptop as it is on its usual environment, up in the Microsoft cloud. It's not a good idea to escape ransomware initially and then get stuck running the at-risk environment on expensive cloud-hosted servers. Microsoft is the only player that can own all these pieces and make them stick together coherently. SC



ABOVE More protection against ransomware, if you don't mind

WHAT *PC PRO* READERS WANT: DISCORD

"Two editions – primarily a full fat one with the same CPU requirements as Win11, and then a second version that supports all the Intel CPUs that 11 doesn't, with everything else that can be layered on top from the regular full fat version (purely to prevent a vast amount of e-waste)."
NickL

"I want a choice between AI and non-AI versions, because it seems constant pushing toward what companies want you to have has got so annoying that I now do many tasks by keeping old machines and operating systems offline to handle printing, scanning, video editing and image editing."
SouthendSites777

"Better app and folder management: while I can save apps to the Start menu and put them in folders, it's a bit of a pain. In the 'all apps' list I want to be able to create folders where I can group families of programs together under a name I give them.

Get rid of Control Panel and combine it with Settings. Have proper driver updater functionality so there's no need for a separate app for it. Tools to see what's using my internet connection. Anything that's in the system tray should be obliged to have a tooltip or be clickable to say what it is. Effective troubleshooters. An AI interface that I can describe what I want to do and it manages all the obscure settings that are needed to achieve it."
Nick Gassman

"Really simple: the context menu on app icons in the taskbar should have a command to coerce all the apps' windows onto the top of the z-order on the primary monitor. Apps have too much control over their own window positioning, resulting in gotchas such as placing windows on monitors that are no longer present! Also bringing up conformation dialogs miles away from the main window, and bizarrely at times even buried under other windows! Longer term, there needs to be a new API that takes control of window placement and sizing away from apps to a centralised window manager and forces apps to go through a standardised, open, control interface for adaptive technologies."
John Hind

"A little help file in messages."
Black_Ears (PaulR)

"The old maze screensaver (from 98 days). Turn AI off. Local accounts (without the workarounds and faffing)."
ChrisT



HANDHELD PCs

More than just toys?

The handheld PC market has taken off, but can they be used for more than mobile gaming? Barry Collins puts three models to work





ABOVE Gaming on the go is becoming increasingly popular

We've all done it. Justified a lavish piece of tech spending by telling ourselves that the expensive treat we're buying will come in handy for all manner of purposes. That expensive digital camera that was going to be essential for your YouTube channel, but now only comes out for summer holidays; the Apple Pencil that was going to kickstart your digital drawing side hustle, but does little more than sign the occasional PDF; the monstrously pricy headphones you'd need for mixing tracks for your long-forgotten band that now only serve to make Spotify sound a fraction less scratchy.

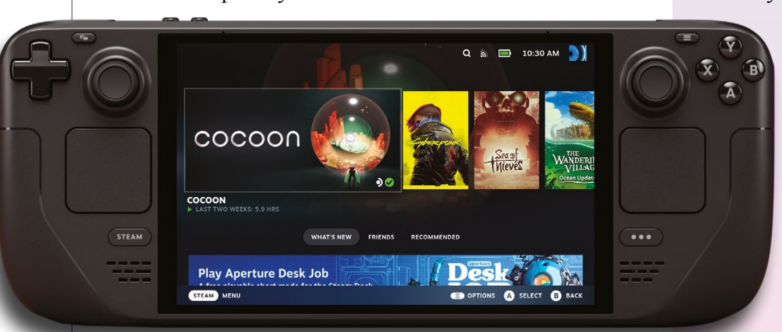
Is the same true of handheld PCs? Of course, we'd all love a poky handheld that lets us play *Cyberpunk 2077* in bed, but can we really justify the expense? Well, what it if were to double as a desktop PC that you could also use for day-to-day computing? As a portable PC that a student could use for bashing out their dissertation as well as foes in *Assassin's Creed*? Is that even remotely justifiable or mere wishful thinking?

I've called in a trio of handheld PCs over the past few weeks to find out if these ostensibly gaming devices are actually fit for proper work – and whether you can truthfully look the other half in the eye and say, yes, this £600 Nintendo Switch-on-steroids isn't just a toy. Honest.

A market is born

The handheld PC is a concept that finally appears to have stuck. The industry has been trying to make it happen for the best part of 20 years. In 2006, Intel and Microsoft teamed up to unveil the ultra-mobile PC (UMPC), a class of handheld devices that often arrived with keyboards awkwardly split on either side of the screen, sometimes with a stylus.

These were largely pitched as business rather than leisure devices, but there were several reasons why the concept didn't fly: primitive mobile processors that rapidly tanked tiny batteries; fuzzy, low-resolution touchscreens; hardware that looked like it had been designed for cosmonauts, not the 7:34 to London Victoria. Then iPads came along in 2010 and completely smashed the



BELOW The top-end Steam Deck comes with an OLED screen

You can look the other half in the eye and say, yes, this £600 Nintendo Switch-on-steroids isn't just a toy

Valve Steam Deck

Not as flexible as its Windows-based rivals, but great for fans of Steam

SCORE ★★★★☆

PRICE £569 from store.steampowered.com

The Steam Deck offers the best outright gaming experience of the three models on test here. Valve's SteamOS is much better adapted to handhelds than Windows 11. There's no fiddling with tiny icons and desktop start menus; everything is slick and well designed for touch/controller operation. Valve has also done a great job of optimising a huge number of games for the Steam Deck, with little or no need to fiddle with controller settings, graphic detail or resolution in most cases.

The Steam Deck offers the best battery life of any of the three on test here, too. I was sent the top-end OLED model with the 50Wh battery, which has a claimed battery life of three to 12 hours, depending on the game being played. I'd put it at the lower end of that scale for the majority of games I played, but you should comfortably get through a day's commuting without needing to plug in, which can't be said for the battery-sapping Windows devices.

The hardware is immaculately designed, with a gorgeous 7.4in touchscreen OLED display flanked by controllers on either side. The Steam Deck is the only device here to have two touchpads, although if you're thinking this opens up *Civ VI*-style games that are traditionally operated by mouse and keyboard, dial down your expectations. They're a struggle unless you're connecting to an external screen, which you can do more easily with the optional £69 docking station.

That docking station's also handy if you want to do more than just gaming, although the KDE Linux desktop just isn't as practical as Windows 11 for day-to-day computing. It also means you need to deploy moderately complex workarounds if you want to stream games from Xbox Game Pass or Nvidia GeForce Now, whereas these are dead simple to set up on the Windows devices.

Still, if you've got a decent library of Steam games and don't want to sit in front of a PC to play them, the Steam Deck is a cracking bit of kit.





granny out of the already struggling handheld PC market, and they were never seen again, outside of commercial environments such as warehouses and factories.

Then the Steam Deck arrived. Valve took its sweet time over the gaming handheld to make sure it got it right. The idea was first mooted in the middle of the 2010s, and by 2018 it looked like becoming vapourware. But, like a devoted *Tetris* player, Valve built a portfolio of games hardware that would all eventually contribute elements to the Steam Deck. There was the Steam Controller, helping drive controller compatibility for thousands of PC games in the Steam catalogue that were mouse-and-keyboard only; the Steam Link that helped refine games streaming technology; and the Steam Machines, small-form-factor gaming PCs that ran on early versions of SteamOS, the Linux-based OS that powers the Steam Deck. While Steam Machines eventually puffed out of existence, they led to the creation of Proton, a translation layer that allows SteamOS to run Windows games.

The Steam Deck was announced in summer 2021 and was an instant hit. Valve doesn't release sales figures beyond that it had shipped "multiple millions" of Steam Decks late last year. The appetite for the Steam Deck was enough to convince companies such as Lenovo, Asus and MSI to give it a go themselves, creating handheld devices running full-blown Windows 11 in 2023.

Now, the market looks here to stay. And if you're thinking about buying one, you might be wondering what else these things can do apart from gaming. But before we get to that, a little about the gaming performance itself.

Gaming PC performance

Let's be frank. As much as we're going to talk about how these things do have a purpose beyond gaming, there's no arguing their primary function is fun. Nobody in their right mind is buying a handheld PC with joysticks either side of the screen if they don't care about gaming.

The first thing to bear in mind here is that while, yes, these are gaming PCs, they're not going to match the performance of a desktop. Think more mid-range laptop graphics performance than tower PC with a GeForce RTX 4080 blowing a new hole in the ozone layer inside.

That said, they are capable of playing some pretty demanding games. *Cyberpunk 2077*, *Elden Ring* and *Diablo IV* are among the titles capable of running on the Steam Deck, albeit not at full graphical punch. It's a similar story with the Asus ROG Ally and Lenovo Legion Go. Both can produce playable frame rates in *Cyberpunk* and *Shadow of the Tomb Raider*, but you'll be hovering at around 30fps rather than a slick 60fps.

Dial down the expectations and these things start to shine. Older titles such as *Portal* and *Half-Life 2* run like a dream. As do less graphically challenging modern titles, such as the in-fashion deck builder *Balatro*. Mobile-oriented games such as *Stardew Valley*, *Terraria* and *Democracy 4* are also perfect for this form factor.

They're also spot on for streaming. The Windows-based devices come with the Xbox app, so if you're a Game Pass Ultimate subscriber you can stream a huge catalogue of titles without any worries about the graphical performance; your chief worry will be your Wi-Fi. *FIFA 23*, *Fortnite*, *Forza Motorsport* and even some titles that don't begin with "F" all await and are well suited to the handhelds. GeForce Now works fine on the Windows handhelds, too, adding another top-quality streaming option. In fact, these devices are in many ways better suited to streaming than installing games locally, not least when it comes to battery life (think less than two hours for demanding games). You can even wrangle Xbox streaming on a Steam Deck with a reasonably complicated workaround provided by Microsoft itself.

However, not all types of game suit the handheld format, including epic strategy games and management sims. They run, but the small screen and controller interface don't make playing fun. These types of game often have small icons or text, too, which are incredibly hard to read on 7in or 8in displays.

Such games aren't completely off limits, though, because you can dock these handhelds, connect them to a monitor and peripherals, and play that way. I got a very credible average of 43fps from the *Civilization VI: Gathering Storm* benchmark on the Lenovo Legion Go, which proves the versatility of these devices. And docking is what broadens the scope of these handhelds well beyond gaming.

TOP **The Lenovo Legion Go excels for streaming services such as Xbox Game Pass**

ABOVE **Valve has built a hugely successful product in the Steam Deck**

Nobody in their right mind is buying a handheld PC with joysticks if they don't care about gaming



In the dock

Docks are game changers for these devices. Game changers in the sense that they let you do something other than gaming. Both the Steam Deck and the Asus ROG Ally have official docks (sold separately) that allow them to connect to screens and other peripherals. Lenovo's Legion Go somewhat surprisingly doesn't have an official dock, but it worked fine with my regular Thunderbolt 3 offering, albeit with its own power adapter also plugged in. A vast range of third-party docks are available for all of these handhelds.

For the Windows 11 devices, the dock turns them into a regular PC – and one with a reasonable dollop of graphical performance. Video editing, photo editing and other graphics-intensive tasks are well within their grasp, although again you're dealing with mobile components, not full-blown desktop hardware, so temper performance expectations.

To give you a sense of the performance on offer, in the Geekbench 6.2 benchmarks the Lenovo Legion Go scored 2,229 in the single-core test and 10,231 in the multicore. The Asus ROG Ally scored 2,498 and 11,856. To put those scores into perspective, the Dell XPS 14 we reviewed in issue 356 – £2,800 worth of laptop with a 16-core Intel Core Ultra 7 155H processor and 32GB of RAM – scored 2,400 and 12,951 respectively. The new M3 MacBook Air 13 racked up 3,148 and 11,893.

In other words, you're not just getting a gaming handheld here. With the addition of a cheap dock, you're getting a perfectly usable general-purpose PC that would be more than capable of most day-top-day PC tasks or suitable for students looking to save space in digs. At a stretch, you could even use the handheld's screen as a secondary display. The Legion Go detaches from its controllers and even has a kickstand on the back, so you can sit on your desk and use it as a small display. Given the size and resolution, it's hard to read much from it unless you've got 20/20 vision, but I happily had it running a stream of a football match while I played a game on my desktop monitor.

What of the Steam Deck? Well, that too has a desktop mode, accessed by holding down the power button for a couple of seconds and selecting it from a pop-up menu. The Steam Deck has a KDE Plasma desktop interface, and you can use the Discovery Software Center to install apps such as browsers, LibreOffice and anything else you might desire. The Software Center uses Flatpak, which – according to Valve – means you can "install and run applications on Steam Deck on the writable part of the disk, with all

With the addition of a cheap dock, you're getting a perfectly usable general-purpose PC



ABOVE Lenovo's Legion Go is a well-designed but weighty handheld





BELOW The Legion Go has detachable controllers and a kickstand on the rear

Lenovo Legion Go

The best Windows handheld PC with clever design touches to help mobile pros

SCORE ★★★★☆

PRICE £649 from lenovo.com

Lenovo has put a lot of thought into the design of its gaming handheld, making it a hugely flexible device. For instance, it's the only device here with detachable controllers. Not only does this mean you can (slightly awkwardly) use the controllers when you've got the device itself attached to an external display, it means that if a controller were to break you wouldn't have to replace the entire unit.

The device also has a Surface-style kickstand on the back, meaning you can prop it up on a plane tray or train table and smash through Netflix boxsets without having to hold the thing – something of a relief, given it weighs more than 850g with the controllers attached, making it by far the heaviest of the three here.

The Legion Go absolutely excels for streaming services such as Xbox Game Pass and GeForce Now. Being a Windows 11 device, those apps are either pre-installed or easy to download, and with Wi-Fi 6E on board, I enjoyed rock-steady streams from my Wi-Fi 6 router, even from a room or two away.

The other big advantage of streaming rather than installing locally? Battery life. As streams don't put huge demands on the hardware, you can eke out four to five hours of life from the Legion Go. However, even with undemanding local games such as deck builder *Balatro*, battery life barely hit the two-hour mark. You'll need a power socket on a long-haul flight, so better book Business Class.

The Legion Go's controller layout is sensible, with a trackpad on the right-hand side making it easier to navigate Windows 11's fiddly menus than relying on touch alone. There's no official dock for the Legion Go, but it worked fine with my generic Thunderbolt 3 dock, meaning connecting displays and peripherals shouldn't pose any problem, giving you a very capable Windows PC at a low-end price.

The major thing you'll need to keep an eye on is storage. With only 512GB of onboard storage and no slot for expansion, you may have to ration games with hefty storage demands.



the rest of your games and content – ensuring it won't be broken by future Steam Deck system updates".

I did notice some oddities when I was using the Steam Deck in desktop mode. For example, software downloaded from the store absolutely dribbled down the pipe, as if I was connected to a 56K modem, not a gigabit connection. Once the software was installed, the network speed was largely fine, but the desktop experience feels more sluggish than with the two Windows 11 devices.

Whether you can get on with a Linux desktop instead of Windows is entirely down to personal choice. But if your work is largely browser-based or consists of lightweight office duties it shouldn't pose any great problems.

Not very mobile

Oddly, however, these battery-powered handheld PCs make better desktop, rather than laptop, replacements. First, the screens are too small to do any serious work on, even if you connected a Bluetooth keyboard and mouse. You'd need to zoom a Word doc to about 400% to make it readable from a normal typing distance and the scrolling would be unbearable.

They're fine for consuming content – watching movies, for example, or even a bit of basic web browsing – but then so is your phone and that's much better suited to the job. Not least because you don't have to deal with Windows 11's questionable touch support on a screen with tiny icons.

Battery life is another factor, too. As I stated earlier, you can expect less than two hours of battery life from the Windows 11 devices if you're gaming natively. Play something demanding and you may even be closer to an hour. If you've bought a gaming handheld so you can have a blast of *Fallout 4* on the bus, you don't want to be wasting that precious battery life by using it to stream movies or browse Tom's Guide.

ABOVE Asus' ROG Ally provides strong performance – if you can get it to work

BELOW You can expand the ROG Ally's potential with the optional dock

Your conscience is clear

Overall, then, if you've been eyeing up a handheld gaming PC and were desperately seeking secondary reasons to justify the outlay, you can in all conscience claim they're fine as a general-purpose PC, too. Especially the Windows devices.

Whether you'll actually ever use it in desktop mode or it will spend its entire life as a Nintendo Switch with benefits is down to you. It does take an awful lot out of one waging campaigns in *Destiny 2*, after all...

These battery-powered handheld PCs make better desktop, rather than laptop, replacements

Asus ROG Ally

Not as well built as the Lenovo, but that is at least reflected in the price

SCORE ★★★☆☆

PRICE £549 from amazon.co.uk

Right up front I have to say that both joysticks had failed on the ROG Ally review unit I was sent by Asus, with neither responding to movements on the X-axis. Initially, I put this down to a firmware glitch, but a spot of Googling revealed many Ally owners with similarly failed hardware. Given the controllers aren't detachable, that either means sending the whole unit back or attempting a hairy DIY repair.

There's another reason to swerve this first iteration, too. As we went to press, Asus announced a revamped ROG Ally X, which will have the same chipset and screen, but much better battery life, according to Asus. That's a relief, as our review model flagged after less than two hours in even undemanding games.

Sticking with the same AMD Z1 Extreme chipset is fine, because I had no complaints about performance with the original Ally. I saw a solid 60fps from *Rocket League* on the built-in screen and never felt at a competitive disadvantage from wireless lag. It benchmarked better than the Legion Go, too.

The 7in IPS screen (which also stays) doesn't have the same visual punch as the Steam Deck's OLED display, but it's no disappointment. Especially as the 120Hz refresh rate keeps faster-moving games blur-free.

The controller layout is sparser than the other two models here. There are no trackpads, which can make navigating Windows 11 menus by touch alone frustrating. It also has far fewer buttons than either the Steam Deck or the Legion Go, making it a weaker choice for those who like to customise controls to the nth degree.

Asus offers an official dock (£60), which supports 4K at 60Hz or Full HD at 120Hz via the HDMI output. However, there are no extra USB inputs for peripherals, so you may wish to consider third-party docks. You might also want to supplement the 512GB SSD; although the unit does have a built-in microSD card slot to help with that. ●

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Norton Parental Control provides tools to see exactly what your kids are up to on their various devices, and you also get GPS location monitoring for Android and iOS.

To round things off, Norton Password Manager generates and stores passwords across all your devices, while SafeCam for PC stops cybercriminals attempting to take photos with your webcam without your knowledge.

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■ pcpro.link/win11pro



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The first reason is simple: price. Microsoft charges £119.99 for a retail licence of Windows 11 Home, and a staggering £219.99 for Windows 11 Professional. By choosing an OEM licence – and avoiding the many dubious sources of licences you may find online – you cut that price substantially.

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■ pcpro.link/avast

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10 ways to transform your life with ChatGPT

Nik Rawlinson finds how AI can help with your everyday tasks, from productivity to entertainment and travel

Short for "Chat Generative Pre-trained Transformer", it's no exaggeration to say that ChatGPT has changed the world. In this feature, we explain how it can transform your life in some very specific and practical ways.

To get the most out of ChatGPT you'll have to pay. Developer OpenAI offers use of the GPT-3.5 engine for free, and limited access to GPT-4o, but paying subscribers get full access to the more advanced model. Plans start at $20 per user per month for the personal tier, which also includes the DALL-E image creation tool.

The simplest way to use ChatGPT is through a web browser, directly on the OpenAI website (**chat.openai.com**). But a huge number of third-party services have also been built on top of the platform, giving you convenient ways to access specific capabilities of the AI.

The problem, as with any digital gold rush, is working out which implementations are actually useful and worthwhile. Here are our recommendations – ten of the best AI applications that really can save you time and enhance your daily life, both in work and at home.

1 Manage your email

Workflow automation platform Zapier (**zapier.com**) lets you connect ChatGPT to Gmail and other messaging services, including Facebook Messenger and Microsoft Outlook. The AI can then automatically compose replies to incoming messages; when a new email arrives in your inbox, Zapier passes its content to ChatGPT, which writes a personal response. This is then saved as a draft for you to review and optionally edit before dispatch.

If you prefer to write your own responses from scratch, you can use Zapier to automatically label incoming messages to make them easier to find, extract information from labelled emails and send details to a Google Sheet for further analysis – or summarise emails as they arrive, so you can quickly decide whether they're worth your attention.

If you're using Outlook, you can alternatively take advantage of Microsoft's own ChatGPT-based email tools, which can summarise long email conversations – a convenient way to catch up if you've been away – or draft messages on your behalf. Note that this requires an **outlook.com**, **hotmail.com**, **live.com** or **msn.com** email address – you can't currently use it with third-party providers such as Gmail.

2 Search smarter

If you're searching the web for specific information, it can take some exploration to find the right terms: for example, if you have a problem with your car, you might first need to research whether the issue lies with spark plugs or glow plugs.

You can get better results by swapping your search engine for an answer engine. Phind (**phind.com**) bills itself as an "intelligent answer engine for developers [that] uses generative AI to get you from idea to solution" – but despite the focus on developers, it's certainly not limited to technical queries. You can ask it general questions on any topic, and

> A huge number of third-party services have been built on top of the platform, giving you convenient ways to access specific capabilities of the AI



default, anything you type into Gemini may be monitored by human overseers, but if you want to protect your privacy you can opt out of this review process by turning off Gemini Apps activity for your account at **tinyurl.com/358gemini**.

ChatGPT 3.5

You
how do i make a lemon drizzle cake

ChatGPT
Making a lemon drizzle cake is quite simple and utterly delicious! Here's a basic recipe to get you started:

Ingredients:

For the cake:
- 175g (6oz) butter, softened
- 175g (6oz) caster sugar
- 175g (6oz) self-raising flour
- 3 large eggs
- Zest of 2 lemons

For the drizzle:
- Juice of 2 lemons
- 100g (3.5oz) caster sugar

Instructions:
1. Preheat your oven to 180°C (350°F) and grease and line a loaf tin with parchment paper.
2. In a mixing bowl, cream together the softened butter and caster sugar until light and fluffy.
3. Gradually beat in the eggs, one at a time, adding a spoonful of flour with each egg

Message ChatGPT...
ChatGPT can make mistakes. Consider checking important information.

3 Get help and inspiration for household tasks

ChatGPT is a high-tech wonder, but it can help with some very down-to-earth domestic questions. I asked it: "What can I make with 500g of left-over mushrooms using only store-cupboard supplies?" ChatGPT suggested mushroom pasta, then pulled up a list of ingredients and a step-by-step preparation method – with none of the tangential preamble normally found on recipe blogs.

It's not only in the kitchen that AI can lend a hand. I asked Microsoft Copilot how to fix a push-button toilet that wouldn't flush; it came back with a six-step procedure, along with a link to a YouTube video showing how to remove the old mechanism and replace it.

receive narrative, natural-language responses in reply. All sources are cited and linked so you can explore further, and Phind even suggests possible follow-up questions.

Another option is Google's Gemini chatbot (**gemini.google.com**), powered by the company's AI formerly known as Bard. It works in the same way as Phind, providing narrative responses to plain-language questions. As Google warns, by

ABOVE By using AI to search the web, you can get straight answers rather than pages of search results

ABOVE RIGHT Lost in the kitchen? Ask AI for help

Although ChatGPT has access to a vast trove of information, you might need to give it guidance to get the most relevant answers. When I asked Phind what kind of front door lock was most secure, it replied with reference to US products and reviews; adding "make your answer relevant to the UK" was enough to get it to return information from UK sources, including several British locksmiths. It also recommended that I look for

"options that adhere to British Standards (BS)", and directed me towards BS 5-lever mortice locks, anti-snap Euro cylinder locks and multi-point locking systems.

Helpfully, the AI also advised on ways to save money, noting that for composite doors, "if they have been tested to PAS 24 and carry a Secure by Design certificate, then the lock has been tested to a very high level of attack, and new locks are not needed. If the door is untested, changing the lock cylinder to a Sold Secure SS312 Diamond cylinder or TS 007 3-star cylinder will prevent locks from being broken and burglars from gaining entry." Even if you think you know what you're doing about the house, the AI may have practical advice to share.

4 Code more efficiently

Last year, Google revealed that it had put ChatGPT through the same coding tests that it uses when hiring new programmers – and that the AI had done well enough to land an L3 Software Engineer position, with a salary of up to $241,000. So if you need to write any sort of code, from a simple shell script to a complex bespoke application, AI can almost certainly help.

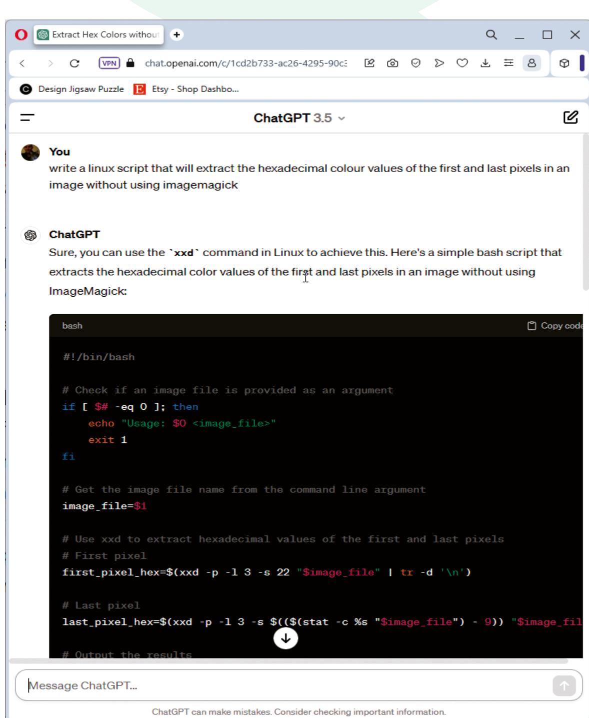
What's particularly impressive about AI coding is how effectively the algorithms can translate natural-language concepts into working code. For example, I tried asking WPTurbo (**wpturbo.dev**) to produce a WordPress script that would prompt the user for a date, then retrieve summaries of any content posted in the following seven days; it might have taken even an experienced programmer an hour or so to knock up the relevant routine, but WPTurbo generated precisely what I needed in a matter of seconds.

Blackbox AI (**blackbox.ai**) is another service designed to answer coding questions and produce complete scripts. I tested it by asking it to generate a PHP script to monitor a web page for changes and send an alert by email as soon as it spots one; the answer appeared in less than a minute.

Microsoft Copilot is likewise well tooled up for coding. I asked it to "write a bash script to extract the hexadecimal colour values of the first and last pixels in an image without using imagemagick". It partially fulfilled the brief, providing working code to do just that. My only quibble was that, rather than generating a bash script, it actually used Python. Fortunately, it's not difficult to run Python scripts from a Linux command prompt.

And for professional developers there's GitHub Copilot (**copilot.github.com**), which claims to be "the world's most widely adopted AI developer tool". A $10-per-month subscription (or $100 per year) gets you unlimited interactions, live code suggestions, debugging and security remediation assistance. If you upgrade to GitHub Copilot Enterprise ($39 per user per month), it will provide custom suggestions based on your organisation's knowledge base.

In all cases, you should be a little cautious of AI-generated code, and check and test it carefully to make sure it fulfils your brief and doesn't have any concerning quirks. But this can still be a much quicker and more productive way to work than turning everything out by hand – and you can improve your own coding skills by studying how the AI solves your problems and achieves your goals.



LEFT Need help coding a function or script? AI is often the quickest route to an answer

ABOVE We gave Magic Write a few keywords and it produced 255 words in seconds

5 Writing with AI

Want 100 words of text on any given topic? Just ask ChatGPT. Natural-language generation systems can churn out all sorts of content, from news articles to fantasy fiction. They can't yet replace the human touch: nuanced storytelling, subjective interpretation and emotional resonance remain difficult for AI to render convincingly. But you can use AI today to help with all sorts of tasks, from job applications to blog posts, presentations and lengthy project proposals.

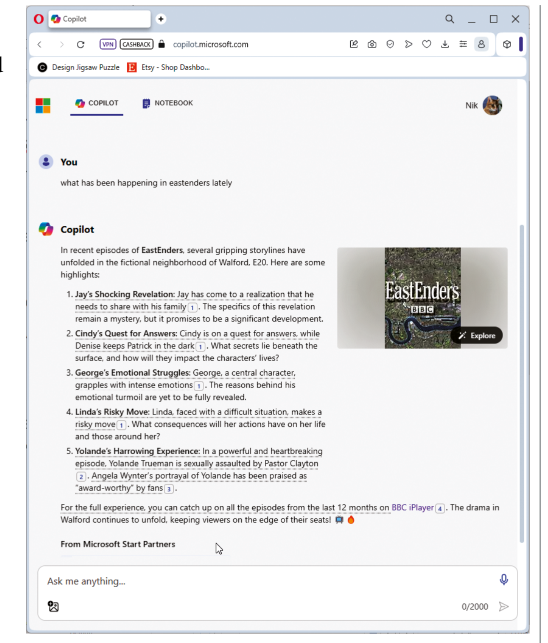
Canva's Magic Write (**canva.com/magic-write**) is one OpenAI-powered tool that can turn keywords into copy, draft long-form articles, extend and develop existing text or condense it into concise summaries. Perplexity (**perplexity.ai**) is another AI tool that can be particularly handy for those who work on the web, as its Chrome extension can automatically grab and process the text you're looking at in the browser.

6 Mine and summarise online content

As well as processing supplied text, ChatGPT and other AI engines can help you find live information on the internet. I asked Phind "What was discussed on the latest edition of the *PC Pro* podcast", and received an instant reply based on the published episode summary, even though the episode had only gone live that day. Similarly, I asked Microsoft Copilot "What have I missed in the last two weeks of *The Archers* on Radio 4?", and received single-line summaries for each episode, along with a link to the relevant episodes on iPlayer.

If you've lost interest in a book, you can also use AI to save yourself the

chore of reading what remains – assuming the text is available to it. I tried asking ChatGPT for a 100-word summary of the last chapter of *Great Expectations*; its response not only outlined the key events, but gave them context, noting that the novel "concludes with a sense of closure as Pip reflects on his journey, finding contentment and acceptance in his newfound humility and the simple joys of life, leaving behind his great expectations".



LEFT Missed your serials? Just ask ChatGPT what's been happening

7 Communicate across the language barrier

As well as producing new text for native readers, ChatGPT can help you reach an international audience, with the ability to translate supplied text into a huge range of languages. That may not sound very new – Google Translate has been doing the same thing for years – but ChatGPT lets you apply more nuance to your translations. For example, you can ask it to use a friendly tone that's suitable for children, or write more formally for professional communications.

As well as translating text into other languages, ChatGPT's conversation-style interface makes it a powerful tool for improving your own fluency

ChatGPT also benefits from its ability to remember input across multiple exchanges. This makes it very quick and easy to make multiple translations of a passage: just enter "translate the following text into French", then follow up with "now translate it into German", "now Spanish" and so on. Officially the service supports more than 80 languages, though it might not be as fluent in some of them as others – as always with translation, it's best to run your output past a native speaker before publishing it to the world.

8 Brush up your own language skills

As well as translating text into other languages, ChatGPT's conversation-style interface makes it a powerful tool for improving your own fluency. Gliglish (**gliglish.com**) is an online chat system that allows you to have interactive, AI-powered conversations or role-play scenarios in more than 30 languages. You can use it without charge for 10 minutes every day, with conversations capped at 50 messages, or upgrade to a paid plan at €29 a month or €276 annually.

While Gliglish focuses on spoken-word interactions, Talkpal (**talkpal.ai**) uses GPT to provide a classic text-entry environment with a focus on conversation. Established language brand Berlitz (**berlitz.com**) has also moved beyond the tapes and records that made its name and partnered with Microsoft, using Azure AI Speech to deliver new content to learners and to gauge the accuracy of users' own speech through pronunciation assessment.

The popular Duolingo platform (**duolingo.com**) has also recently started using GPT-4 to power its new Duolingo Max subscription service. This includes an "Explain my answer" feature, which drops you into an interactive chat session where you can discuss your responses and explore the points of language. There's also a new dynamic role-playing feature, which lets you hold free-flowing, open-ended conversations with the characters that live inside Duolingo. For now this is only available to English speakers learning Spanish or French on an iOS device, but there are plans to extend coverage to other languages and platforms.

9 Discover home entertainment

Too many streaming services and not enough time? Microsoft Copilot can help you pick what to watch by combining the power of ChatGPT with the latest online data. I asked it to "recommend the best programmes of 30 minutes or less on Netflix and Apple TV"; it suggested *Heartstopper* and *Trying* on Netflix, and *Shrinking* and *Mythic Quest* on Apple TV+. "Are these all available to UK subscribers?" I checked – to which it replied, "Yes, all the mentioned shows are available to UK subscribers. Enjoy your binge-watching!"

These aren't particularly bad recommendations: they're popular shows that mostly fit within the requested time limit, although some episodes can run longer, and *Trying* is actually on Apple TV+. Needless to say, you can refine your search by asking for specific types of show, themes or actors.

10 Plan a trip

ChatGPT can't directly read maps, but it has absorbed enough content to be able to provide extensive advice on journeys and destinations. For example, I asked it to "suggest a free day out in Scotland, less than an hour's drive from Inverness, which would be suitable for a family of two adults and two children aged five and seven". It came back with two options, including extensive details of sites to visit with historical context and specific suggestions for children's activities.

The AI can also help you put together an itinerary, for either a single day or a whole holiday. While it can't yet provide turn-by-turn directions like Google Maps, add-on tools can generate maps of waypoints and attractions to assist with travel plans. One good example is ForgeMyTrip (**forgemytrip.com**), which costs $5.99 per month for unlimited usage.

AI today and AI to come

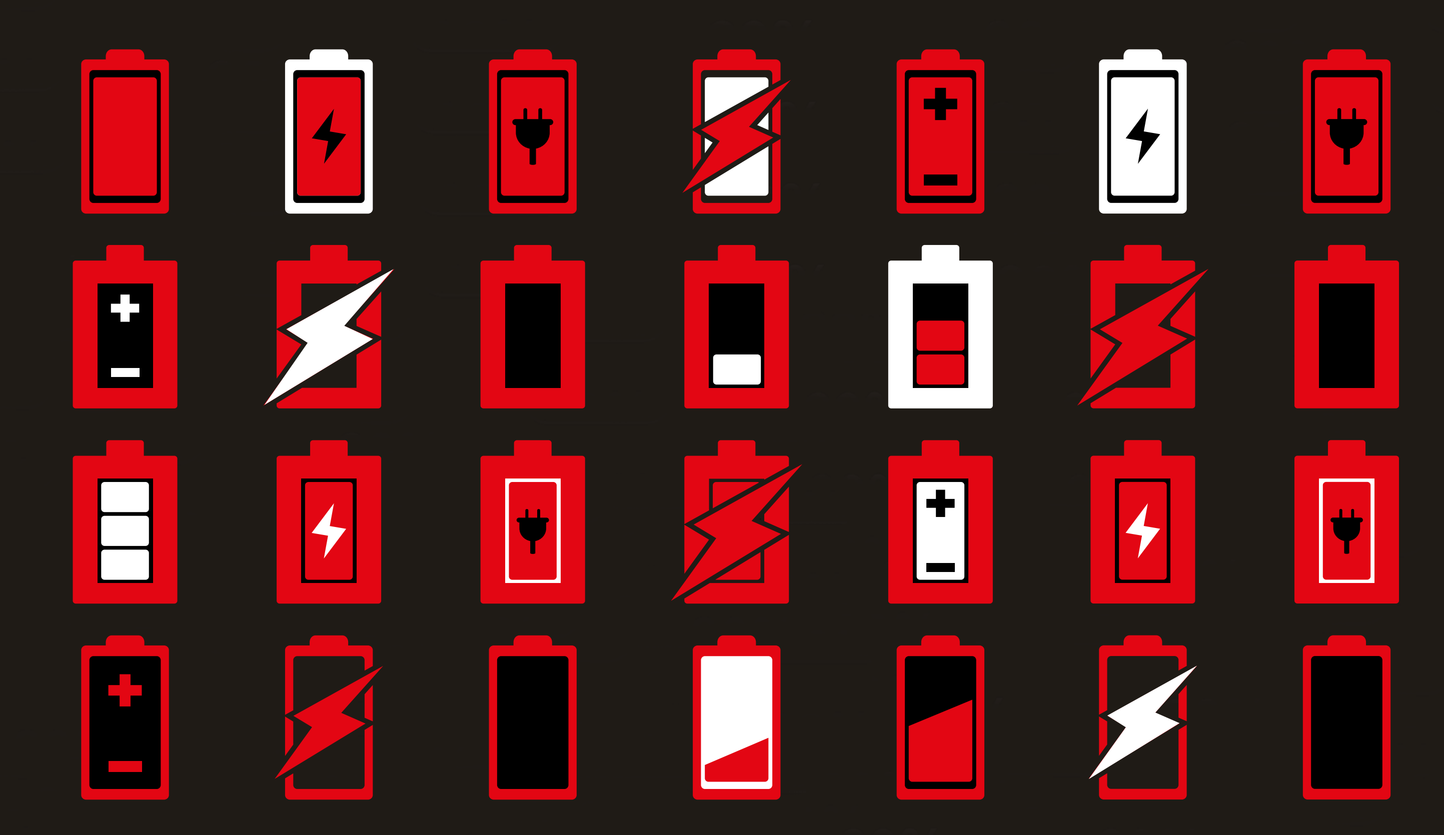
AI can do remarkable things, but it's not always spot on in its answers. Most services will openly acknowledge this, and warn that you should check your AI-generated answers before relying on them.

However, the speed at which the technology is improving is remarkable. Nobody yet knows where AI will ultimately take us, but it's only going to get more powerful – and this will probably result in fundamental changes in the ways we live and work. Speaking on CBS last year, Google CEO Sundar Pichai called AI "the most profound technology humanity is working on. More profound than fire, electricity, or anything that we have done in the past." You can start harnessing its power today.



Charging up

Confused by fast charging, USB PD and Qi? Darien Graham-Smith finds out what's watt and provides some advice on how best to top up your battery-powered devices



Charging up your devices used to be simple: you'd just plug in the right cable, wait an hour or two, then unplug and go. And today, with almost every portable device supporting USB charging, things ought to be even easier.

Unfortunately, there's still considerable confusion. Although the USB Type-C connector has become ubiquitous, the amount of power it actually conveys can vary considerably, depending on which devices and chargers you're using, and even which cables you're using. If you want to charge up your devices quickly and reliably, here's what you need to know.

The bad old days

The original USB 1.0 standard, as published in 1996, was designed to provide up to 500mA of power at 5V – equivalent to 2.5W. This was enough to drive peripherals such as optical mice and external hard disks, and when USB 2 came along in 2000 the power specification wasn't changed.

The problem was that, while lightweight devices could run off a 2.5W USB connection, it would take a very long time for that supply to charge a decent-sized battery. For example, a modern smartphone might have a 10Wh battery; even at a theoretical 100% efficiency, it would take four hours to fully charge from a 2.5W power supply.

To address this, in 2007 the USB Battery Charging specification introduced a new high-power mode to the USB 2 standard, raising the maximum current to 1.5A for a peak power delivery of 7.5W. The update didn't technically require any particular sort of cable or connector, but it arrived at a point in time when the mini-USB format was being phased out in favour of micro-USB, and in 2011 the EU officially mandated micro-USB as a standard charging connector for all smartphones. Thus, for most of the 2010s, you could use a compact USB connection to refill a typical smartphone in under two hours – but it still wasn't exactly speedy.

The dawn of PD

The Battery Charging specification wasn't the only update to USB at around that time. In 2008 the new USB 3 standard came along, not only raising the top data rate to 5Gbits/sec but also adding a new 4.5W power mode, reflecting an awareness of growing power demands.

And in 2012 the completely new USB Power Delivery (PD) standard was released. This enabled all compatible devices to draw up to 2A of current from the host, for a total power provision of 10W, and defined additional optional power modes that raised the amperage to 3A or 5A and the voltage to 12V or 20V, massively increasing the power envelope to a maximum of 100W.

The PD standard didn't catch on right away. Not only did it require new hardware on both sides of the connection, it needed new cables, as existing USB cables weren't designed to carry these higher currents. PD-compatible cables with Type-A, Type-B and micro-B connectors were manufactured, but never became widespread.

Although the USB Type-C connector is ubiquitous, the amount of power it conveys can vary considerably



TOP USB Type-C connectors are now ubiquitous



ABOVE Many modern devices can be charged wirelessly using the Qi standard

LEFT USB PD charging enables far faster top-ups

For USB PD to become truly mainstream, however, one more update was required: the USB Type-C connector, introduced in 2014. The new reversible, symmetrical cable standard not only supported all data transfer modes (including the new USB 3.1 SuperSpeed+ mode), it was designed to carry at least 3A of current. This meant a standard Type-C cable could be used to charge phone batteries at high speed, and even run and recharge powerful big-screen laptops. At last, we could plug any USB device into any power source and know it would charge quickly and successfully – right?

Cables and compatibility

All USB Type-C cables can handle the basic 10W power mode defined by the USB PD standard, which provides 2A of current at 5V. Optionally, the connected devices can agree to raise



the amperage to 3A, and the voltage can be increased to 12V or 20V, to provide additional 36W and 60W power modes.

Unfortunately, the top 100W power tier requires a higher 5A current that not all cables can handle. Compatible cables identify themselves electronically when plugged in, so hosts and devices know when it's safe to use the fastest charging mode – but there's no requirement for such cables to be visually identifiable. This means you can't necessarily tell by looking which cables will support the 100W mode and which are limited to 60W; it doesn't help that some unscrupulous manufacturers have been known to mislabel their cables, assuming that users won't notice the difference.

Recently things have become even more confusing. In 2021 the latest version of the USB PD specification added new "extended power range" (EPR) options. These allow USB hosts to freely dial the amperage and voltage up and down, rather than being limited to preset values, so devices can draw precisely as much power as they need. At the same time, the voltage limit has been raised to 48V, enabling a maximum power supply of 240W when used with an EPR-compatible cable.

While this is great for quick and efficient charging, it means that there are now three types of cable in circulation, supporting different wattages, and a huge variance in the capabilities of different power supplies. Again, there's no requirement for EPR ports or cables to be clearly marked in a way that's readable to humans, nor any enforcement to ensure that a USB power accessory can actually deliver its advertised power capabilities.

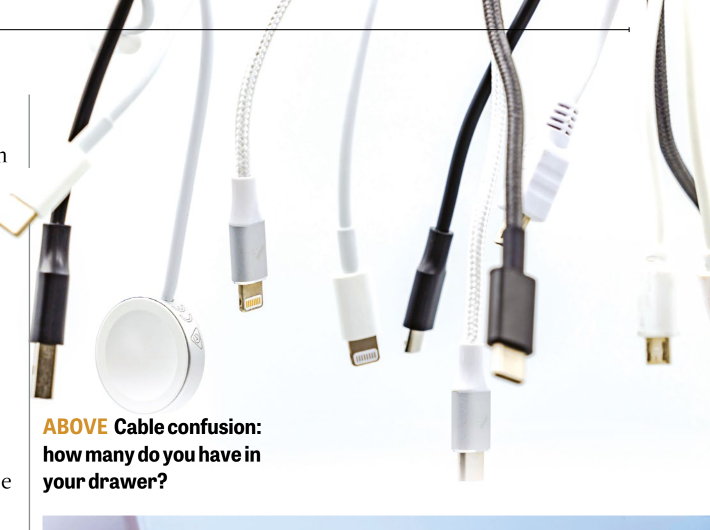
How do I know I have the right cable?

All of the above creates a conundrum if you want to charge your phone and laptop as quickly as possible. Almost any modern charger and cable will bring up the "charging" indicator, but how can you tell how much power is actually flowing through the cable?

There's often no easy way to discover the power capacity of a USB Type-C cable, or indeed to determine whether a charger is putting out as much juice as the cable can support. If you have a collection of cables and chargers, however, you can try a comparative test: use each combination to charge a Windows or macOS laptop, and check the battery details to see how long the operating system estimates it will take to fully charge. The number you see won't directly tell you how many watts the computer is drawing, but you may well see that it goes up and down with different chargers and cables. (For reasons we'll explain below, it's best to try this with a battery that's less than 50% charged.)

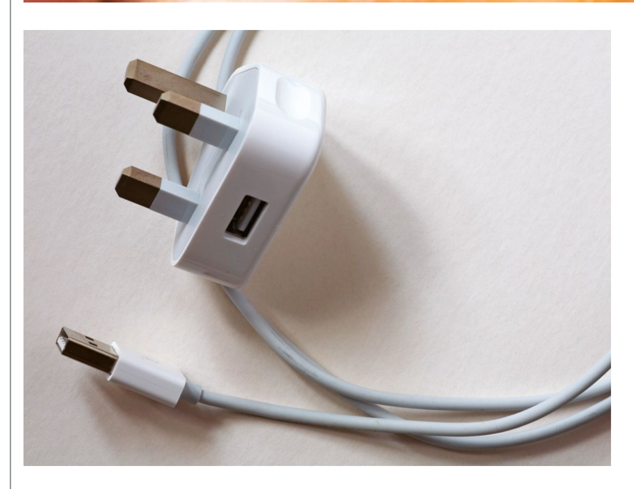
If you want to know exactly how much power is being transferred over a USB cable, you'll need to invest in an inline power meter. These aren't expensive; you can get one from Amazon for under a tenner (see **tinyurl.com/358tester**) that will tell you exactly how many volts and amps are travelling down the line. Remember that this doesn't necessarily tell you the maximum supported wattage of the cable, the charger or the connected device, any of which might be capable of going higher.

If your charging speeds are being held back by a low-wattage cable, your only solution is to replace it with a faster one – for good reasons, no USB controller will allow you to exceed a cable's hard-coded power rating. Big-brand EPR-certified cables are more expensive than generic ones, but you can be confident that they'll deliver the maximum power supported by your devices, so you might well be glad you paid the extra when you need to top up your phone in a hurry.



ABOVE Cable confusion: how many do you have in your drawer?





ABOVE When a laptop's battery is close to full, it may use trickle charging

Why do some things charge faster than others?

Almost all modern smartphones support some degree of "fast charging" – that is, charging at a higher wattage than the 10W base rate of the USB PD standard. Current iPhones will charge at 20W when



LEFT An inline power meter can tell you exactly how much power is being transferred over a USB cable



plugged into a suitable supply, while the Google Pixel 8 Pro goes up to 30W, allowing it to half-fill the battery in around half an hour. Some OnePlus handsets can reach a massive 100W, allowing them to recharge from empty to 50% full in little more than ten minutes.

Why, you might wonder, don't we use the maximum 240W mode for near-instant charging? The simple answer is that, like most chemical reactions, charging a lithium-ion battery generates heat. This breaks down the chemicals in the cell, reducing the battery's charge capacity – and the more watts you shove in, the hotter it gets and the worse the degradation.

Even with regular 10W charging, a phone battery might lose 5% of its capacity in a year, so building fast charging into a phone requires an investment in heat management. Each phone manufacturer makes its own decision as to how to balance that against convenience and battery health. No-one has yet come up with a practical smartphone design that can survive charging at 240W, so that power mode is currently only useful for desktop devices, such as all-in-one PCs and monitors.

enabled unless you know that you're planning to get up unusually early.

What about wireless?

So far we've focused on USB charging, but many modern devices also support wireless charging. Most implementations of this follow the Qi standard, created and maintained by the Wireless Power Consortium, a cross-industry consortium that includes Apple, Google, Qualcomm and Samsung.

Qi charging uses a flat pad or stand containing an electromagnet, which induces a current in a nearby Qi-compatible device, which can in turn be used to charge a battery. The available power is less than with a cable: the original implementation of Qi, released in 2010, could provide up to 5W of power, and in 2015 this was increased to 15W. At present that remains the maximum supported by most phones, a notable exception being the OnePlus 8, which uses a proprietary wireless pad to achieve 30W charging.

As well as providing less power, Qi is less energy-efficient than a USB cable. With wired charging, around

You can't necessarily tell by looking which cables will support the 100W mode and which are limited to 60W

Another factor is that the heat generated by charging at a certain wattage isn't constant. An empty battery will stay quite cool while charging quickly, but as it gets closer to its maximum capacity, the heat generated increases – so the phone will automatically reduce its charging rate to avoid overheating. This is why manufacturers like to focus on how quickly a phone can get to 50% charge, as it will probably take much longer to reach 100%.

The same applies to laptops, which is why we recommended using a laptop with a low battery above: if it's close to full, it may be "trickle charging", which won't tell you much about the capabilities of your charger and cable.

Similarly, many smartphones use "smart charging" when left plugged in overnight – learning your daily routine and charging your battery as slowly as possible, so it gets to 100% just before you want to get up and unplug it. If it frequently gets it wrong, you can disable the feature, but ideally you should leave it

90% of the power drawn from the mains typically makes it into the battery, whereas with inductive charging the figure is closer to 70% – although it can be significantly lower if the device isn't perfectly aligned with the magnet inside the charger.

Clearly, wireless isn't the best choice if you want to recharge quickly, or to top up from a portable battery which itself has limited capacity. Qi is better suited to overnight charging from the mains, or for devices with small batteries such as smartwatches.

Things are changing, though: the Qi2 standard, introduced last year, adopts Apple's MagSafe model, using magnets to snap devices into place to avoid alignment problems and maximise charging efficiency. What's more, while 15W remains the top charging rate, the standard allows for future increases to 65W and beyond. Hopefully it won't be long before wireless charging is fast and practical enough for everyday use, and we won't have to worry about charging cables at all – or at least, not as much.

Legacy chargers

What works with what?

While most modern laptops have embraced the USB PD standard, there are still plenty of older models using traditional barrel connectors – as well as routers, displays, storage devices and all sorts of other gadgets.

There's nothing wrong with barrel connectors, but they're a dumb technology. With USB, the charger and device negotiate to ensure the right number of amps and volts are sent down the cable; with a barrel charger, you just get whatever comes out of the power supply, and if that blows up your laptop then so be it.



ABOVE All electronic devices will have a label stating their power requirements

Understandably, therefore, buying a spare power supply (or replacing a dead one) can be an anxious task – but it doesn't need to be. The hardest part is often finding a supply with the right physical connector: you need a connector with the right outer and inner diameters, to fit your socket and connect securely to the electrical contacts. You might need to do some careful measuring or investigating to get this right.

As long as the physical side of things fits, it's easy to match up the power requirements. All consumer electronic devices sold in the UK must have their power requirements marked on the exterior. With a laptop this will typically be on a label on the underside. Amid the various certification and compliance marks, you're looking for a number like "19.5V ⎓ 3.42A", indicating that the device requires 19.5V DC at 3.42A.

Once you find this information, you just need to find the corresponding label on your power supply and check that it matches. Most laptops require 19.5V; if you try using a 12V supply then the system might boot up, but it will be severely underpowered and might crash as soon as you try to load a demanding program. Go over 19.5V and you're in danger of making the laptop overheat, which will again make it unstable, and could permanently damage it.

You can be more breezy with the amperage: here, the number shown on your laptop label represents its theoretical peak demand. While we can't exactly recommend that you use (say) a 2A supply with a laptop that's labelled 3.42A, you may well be fine as long as you don't load it up with power-hungry USB peripherals and processor-intensive games. And there's no need to worry about going higher: if your power supply is rated at 5A, that just means it has more headroom than your laptop will need.

A final point to be aware of with barrel connectors is polarity. Almost all laptops use centre-positive plugs and sockets, but if there's a polarity indicator on the laptop or charger it's worth confirming that the inner circle is marked with a plus symbol and the outer ring is marked as minus. If you plug a centre-negative connector into a centre-positive socket (or vice versa) then hopefully the board will be smart enough to reject the current and refuse to turn on. Otherwise you may be looking at a puff of smoke and a pricey repair.

ABOVE Barrel connectors are commonly found on many older laptops, as well as lots of other gadgets

The biggest, best, most exciting products in technology – reviewed and rated

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Apple iPad Pro (M4)

With ridiculous levels of power stuffed into its 5.1mm-thin frame, this is a triumph of design – but do you need it?



SCORE ★★★★★

PRICE 13in/256GB, £1,083 (£1,299 inc VAT) from apple.com/uk

The iPad Pro has long been the best tablet on the market, but Apple isn't resting on its past success. This year's models introduce a new processor, a striking ultra-slim design and the best ever tablet display.

Visually, the new 11in and 13in tablets aren't a radical departure from their M2-powered predecessors, released in 2022. Each one is still a solid slab of aluminium with a large display and a thin profile. However, the mini-LED panel has been replaced by an OLED display – or "Ultra Retina XDR", as Apple dubs it – and it could be enough to justify the upgrade by itself thanks to its deep blacks, scorching whites and beautiful, dazzling colours. The sharp 264ppi resolution means everything from videos to games to comics looks stunning, and a 120Hz refresh rate ensures all motion is smooth.

Our technical tests found that the new iPad Pro's colour reproduction and accuracy weren't much different to those of the previous model, with around 83% coverage of the DCI-P3 space and an average Delta E of 0.2. Even so, the exceptional contrast of OLED technology makes everything appear much richer.

If you buy one of the models with 1TB or 2TB of storage, you can choose to have nano-texture glass on the front of the display, in place of the regular reflective finish. It has a matte appearance and promises to dramatically reduce reflections, without otherwise diminishing the incredible contrast and brightness of the display. It could be a good choice if you want to use your tablet outdoors or in a space with overhead lights.

ABOVE Still the best tablet you can buy – if you've got the cash





BELOW The stunning OLED screen is a real feast for the eyes

Case and camera

While the previous-generation iPad Pro models were hardly thick, the new ones are both thinner and lighter. In fact, they're thinner and lighter than the new iPad Air models (*see overleaf*). The body of the new 11in iPad Pro is 5.3mm thick, while the 13in model is even slimmer at 5.1mm.

Weight-wise, the 11in model is 20g lighter than before, while its larger cousin has dropped substantially from 682g to 579g. That's a difference you can feel in everyday use: with the 2022 12.9in iPad Pro I constantly had to reposition my hands when reading comics, because the big tablet was a fraction too cumbersome to hold. That's no longer the case.

Speaking of changing positions, the front camera is now located along the long edge of the tablet, rather than in the top bezel. This makes sense, since pro-grade iPad apps are mostly used in landscape orientation: it makes participating in video calls, taking selfies and using FaceID to unlock the iPad Pro more natural. My only gripe about the design is that, like the previous model, the new iPad Pro has only a single USB-C port.

M4 difference

Internally, the 11in and 13in models have identical specifications. Both are based on Apple's new M4 processor – a two-generation step up from the previous M2-powered models, with silicon so new that it hasn't yet appeared in any other Apple product.

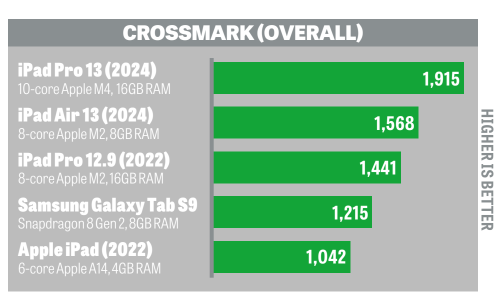
As usual, there are subtle variants of the chips. The 256GB and 512GB models come with 8GB of RAM and an M4 processor with nine CPU cores, a ten-core GPU and Apple's latest Neural Engine (which the rest of the industry calls an NPU). The pricier 1TB and 2TB models get double the RAM, plus one extra CPU core. See the table below for pricing

I tested the 13in 1TB model, and couldn't have asked for more performance. In Geekbench 6, the M4 iPad Pro achieved almost twice the score of its M2-powered predecessor. As our graphs show, it also placed well ahead of the old model in 3DMark.

Unsurprisingly, all of this translates into a snappy experience. My regular workday involves juggling multiple open tabs and applications, but the iPad Pro never slowed down or stuttered for a second – not even when I tossed YouTube videos into the mix. You can play demanding games on this absurdly thin tablet, too: although *Resident Evil 4* wasn't up to the 60fps gold standard, it was still playable. I'm eager to see how iPad games optimised for the M4 chip will perform.

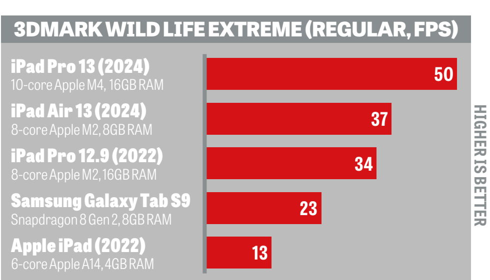
The only loose thread in terms of performance is the iPad Pro's AI capabilities. Introducing the new tablet, Apple proudly drew attention to its latest Neural Engine, calling it "an outrageously powerful device for AI". But so far there's a conspicuous lack of apps that showcase what AI functions can do for you.

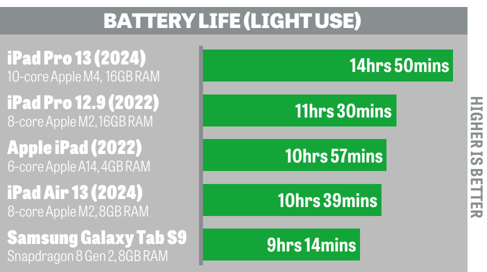
There's better news for battery life. In our light-use test, which involves continuous web-surfing over Wi-Fi with the display set to 150cd/m², the iPad Pro lasted an astonishing 14hrs 50mins. That's a lot longer than the iPad Pro M2's 10hrs 39mins, and well beyond the ten-hour battery life that Apple is advertising.



ADOBE PREMIERE RUSH (LOWER IS BETTER)

Device	Time
iPad Pro 13 (2024) 10-core Apple M4, 16GB RAM	19secs
iPad Pro 12.9 (2022) 8-core Apple M2, 16GB RAM	21secs
iPad Air 13 (2024) 8-core Apple M2, 8GB RAM	23secs
Apple iPad (2022) 6-core Apple A14, 4GB RAM	29secs
Samsung Galaxy Tab S9 Snapdragon 8 Gen 2, 8GB RAM	40secs





Add-on expenses

To get the best from your investment, you'll need accessories. The Magic Keyboard and Pencil have long been almost obligatory partners to the iPad Pro, and both have been updated with the tablet. The new keyboard comes with aluminium palm rests, making it look and feel like a MacBook Air – an effect magnified by the larger touchpad and a flatter hinge.

This is a lovely keyboard to type on, with the aluminium cool and sturdy against your palms, while the keycaps feel thicker and have more travel. It needs to be this good, though, as the keyboard adds at least £299 to the already considerable price. The whole assembly is lighter than before, but still adds a hefty 660g to the iPad Pro's weight.

Then there's the new Apple Pencil Pro (see overleaf for our full review). It looks just like its predecessor, but has nifty extra features such as haptic feedback and a squeeze function to control the input in new ways. Particularly smart is the new gyroscopic sensor in the barrel, which allows you to intuitively twist the stylus to change your line thickness or otherwise adjust drawing styles.



ABOVE The new iPad Pro is thinner and lighter than even the iPad Air

Again, though, it's expensive at £129, so unless you have artistic leanings you can stick with the Apple Pencil USB-C for £79.

Worth the money?

The iPad Pro 2024 is an exceptional piece of technology. Its vivid OLED display is a marvel to behold, while the thin and light design makes it more portable and delightful to use than ever. It's also a fantastic debut for the M4 platform; I can't fault its speedy performance, nor its astonishing battery life.

All the same, once you factor in the keyboard and stylus, the price can easily add up to a lot more than a regular laptop. In fact, you could buy a MacBook Air plus a new iPad Air for less than many iPad Pro configurations.

"The iPad Pro is designed to be the very best tablet you can buy, in all ways and for all purposes, and it absolutely succeeds"

But let's not pretend that this is about value for money. The iPad Pro is designed to be the very best tablet you can buy, and it absolutely succeeds.

If you're willing to pay the price, it does everything you could possibly ask of a tablet, and much more. And for those of us who can't justify the expense, it provides an exciting look at the future – because, make no mistake, the new iPad Pro sets the standard for all tablets to follow.

TONY POLANCO



SPECIFICATIONS (13in)

9-core/10-core Apple M4 processor • 8GB/16GB RAM • 13in OLED touchscreen, 10Hz-120Hz, 2,064 x 2,752 resolution • 256GB/512GB/1TB/2TB storage • 12MP rear camera • 12MP front camera • Wi-Fi 6E • Lidar • Bluetooth 5.3 • NFC • Thunderbolt 4/USB-C 4 • 39Wh battery • iPadOS 17 • 216 x 5.1 x 282mm (WDH) • 579g • 1yr warranty

PRICES OF MODELS WITH WI-FI AND CELLULAR

	11in Wi-Fi	11in cellular	13in Wi-Fi	13in cellular
256GB	£999	£1,199	£1,299	£1,499
512GB	£1,199	£1,399	£1,499	£1,699
1TB	£1,599*	£1,799*	£1,899*	£2,099*
2TB	£1,999*	£2,199*	£2,299*	£2,499*

*Extra £100 with nano-texture glass. All prices inc VAT from apple.com/uk.

Apple iPad Air (M2)

All the power and features most people need, and the 13in version is a match for the previous 12.9in iPad Pro

SCORE ★★★★★

PRICE 13in/128GB, £666 (£799 inc VAT) from apple.com/uk

While Apple's M4-toting iPad Pro models have been grabbing the headlines, the iPad Air has also seen a major update, including the introduction of a 13in model. At £799, it's far cheaper than the 13in iPad Pro, while the new 11in iPad Air costs £599. In both cases the price includes 128GB of storage, with 256GB, 512GB and 1TB versions costing an extra £100, £300 and £500 respectively.

Picking up the new 13in iPad Air I felt instantly at home. It's strikingly light for its size at 617g, and is basically a blown-up version of the last-gen 11in Air, with a larger frame but the same 6.1mm thickness. The 12MP rear camera is in the same spot, as are the volume buttons near the top of one long edge, and the adjacent and responsive Touch ID button.

There are a few changes, though. On both the 11in and 13in models, the FaceTime camera has moved to one of the wider landscape edges, and now sits below the magnetic connector that's used to pair and charge the Apple Pencil. Reportedly this small change required reengineering the charging technology, which is why the new Pencil Pro only works with the latest iPads.

Key attractions

The larger frame pairs comfortably with Apple's latest Magic Keyboard; this hasn't been redesigned to the same extent as the iPad Pro's, but it's still an excellent, full-sized and lightweight keyboard with a responsive trackpad. Just keep in mind that this add-on will add £349 to the price, or £299 for the more compact 11in model. At that point you might consider buying a MacBook Air instead.

One thing that hasn't changed is the screen. The "Liquid Retina" display uses the same technology as last year's model, offering a sharp 264ppi pixel density with eye-pleasing DCI-P3 support. The only minor difference is that the 13in model goes up to a maximum brightness of 600cd/m², while the 11in Air remains at 500cd/m². There's no nano-texture option as with the iPad Pro, but the anti-reflective coating does a decent job in bright light, and the oleophobic film helps repel fingerprints; you can see smudges when the screen is off, but with the backlight on they're all but invisible.

Numbers aside, what matters is the experience, and everything from photos to movies, games, apps, websites and video calls look great on the iPad Air. It only suffers in comparison to the OLED display used on the new iPad Pro models.

Snap, crackle, pop

Both models of the new iPad Air feature an ultrawide f/2.4 lens on the 12MP front camera. This supports Apple's Centre Stage technology, and I've found it works well: when I get up during FaceTime calls and walk around in front of the iPad Air, the camera view automatically follows and crops in to keep me in the centre of the frame. If you take a selfie, the camera will capture a regular ultrawide snap; switch to video mode and it will record 1080p footage at 60fps.

The rear 12MP camera offers a 5x digital zoom, and can even shoot 63MP panoramas if you don't mind holding up the tablet and slowly panning it around you. Test photos came out with lots of colour and detail, although they didn't match the punch and clarity of the camera on my iPhone 15 Pro Max. 4K video can be shot at up to 60fps, or slow-motion 720p video at up to 240fps. Optional cinematic video stabilisation crops the frame to reduce screen shake and give your videos a smoother look.

PC PRO ★★★★★ A-LIST

ABOVE The 11in iPad Air has now been joined by a 13in model

LEFT The rear 12MP camera offers a 5x digital zoom

"The scale of the 13in iPad Air is great for games and movies, and it's also ideal for sketching and digital painting with a stylus"

Soft touch

In the past I never felt like I needed anything more than the standard 11in screen of the previous Air, but I must admit that the scale of the 13in display adds extra enjoyment to games and movies. And it's arguably even better for sketching and digital painting, especially with the Pencil Pro (*see opposite for our full review*). I've always enjoyed sketching on my previous iPads, but with the 13in iPad Air it's now irresistible.

I also love the way I can use Sidecar to connect the iPad to my MacBook Air and use it as a desktop extension, and with the big-screen Air that's more useful and practical than ever. The



BELOW Pairing the iPad Air with a Magic Keyboard is a superb, if costly, option





LEFT iPadOS links seamlessly to desktop Macs

addition of universal control mode, allowing me to seamlessly move my laptop mouse from the Mac screen to the iPad, makes the tablet slot seamlessly into the macOS ecosystem.

M2 power

Both new iPad Air models use Apple's M2 chip, and although that's two generations behind the cutting-edge M4 found in the latest iPad Pro tablets, it's still a powerful processor. With an 8-core CPU, 10-core GPU and 16-core Neural Engine, the scores it produced in the Geekbench 6 benchmark are among the best you'll find on a tablet (*see the graphs on p49*).

This means there's plenty of power for real-world apps. While Apple is clearly pitching the iPad Pro as its flagship creative tool, I had no trouble using the iPad Air to edit 4K video in iMovie or manage dozens of tracks in Logic Pro. The tablet also makes an able gaming platform: I raced around the track in *Grid AutoSport Custom Edition*, and was pleased to see nothing but smooth motion and zero lag. The iPad Air also performed well in *Resident Evil 4*, with smooth motion and only a tiny amount of pixellation in the action sequences.

The landscape stereo speakers, meanwhile – positioned on either side of the tablet – deliver rich audio, although for the full Spatial Audio experience you must pair the tablet with a AirPod Pro 2 headphones. That'll be another £229, please.

Apple claims the iPad Air's battery will last a "full day" of around ten hours. During testing, I often achieved ten hours of activity, although depending on my apps and screen brightness this could fall to as little as eight or even six. Our standard battery test ran for 11hrs 30mins, which compares well to competing tablets.

Airs apparent

Although the new iPad Air models aren't revolutionary, they bring positive performance and design refinements while doubling the base storage of the previous models. And the addition of the 13in model means you can now get the big-screen iPad experience for a just-about-affordable price.

Cash-strapped artists will love it, as will anyone wanting a large, touch-friendly workspace for music and video – and with the addition of the Magic Keyboard it also does an excellent impression of an ultraportable laptop. **LANCE ULANOFF**

SPECIFICATIONS (13in)

8-core Apple M2 processor • 8GB RAM • 13in IPS touchscreen, 60Hz, 2,048 x 2,732 resolution • 128GB/256GB/512GB/1TB storage • 12MP rear camera • 12MP front camera • Wi-Fi 6E • Bluetooth 5.3 • NFC • USB-C 3.2 Gen 2 • 37Wh battery • iPadOS 17 • 215 x 6.1 x 281mm (WDH) • 617g • 1yr warranty



LEFT The tablet is available in space grey, starlight, purple and blue

Apple Pencil Pro

Expensive, of course, but its new features lift the Pencil Pro above all rivals

SCORE ★★★★★

PRICE £108 (£129 inc VAT) from apple.com/uk



Were it not for the "Pencil Pro" branding printed on the end of it, you could easily mistake Apple's new stylus for its predecessor, the Pencil 2. However, the Pencil Pro introduces four major new features.

The first is a squeezable sensor near the Pencil Pro's tip, which provides contextual functions in different apps. In Apple's Notes app, for instance, it makes the radial pen and colour selection tool pop up next to the Pencil's tip. This is superbly convenient, saving wasted hand movements and allowing artists to stay focused on their work. A new haptic feedback motor gently rumbles to confirm the squeeze gesture, and can also provide physical feedback in apps, such as vibrating when aligning a canvas element to a snap grid.

Next up, the "Barrel Roll" feature uses a gyroscopic sensor to let you angle your digital brush by simply rotating the pen – perfect for calligraphy-type flourishes and sweeps. Finally, the Pencil Pro now works with Apple's Find My network, so if you accidentally drop it somewhere, your iPad can help track it down.

The Pencil Pro still lacks the drag and resistance of a real pencil; there remains a plastic-on-glass feel to the whole thing. But considering the flexibility you gain, that's surely a price worth paying.

ABOVE The Pencil Pro is a great stylus, but sadly won't work with older iPads

The most frustrating thing about the Pencil Pro is the fact that it only works with Apple's new M4 iPad Pro or M2 iPad Air tablets. While I understand the technical reason for this, it locks out many millions of existing iPad users – and creates confusion, with Apple now offering four different Pencil models with different features and compatibility.

Still, the Apple Pencil Pro is without a doubt the best stylus I've used. I don't doubt that many artists will consider it worth trading up to a new iPad just to get their hands on the new Pencil. All it needs now is a digital eraser on the end. **GERALD LYNCH**

SPECIFICATIONS

Magnetic Bluetooth pen • 166 x 8.9mm • 19g • requires iPadOS 17.5 or later • 1yr warranty



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Chillblast The Karve

One of the most striking PCs we've reviewed and a good-value choice for gamers – but not for all-rounders

SCORE ★★★★☆

PRICE As reviewed, £1,420 (£1,704 inc VAT) **from chillblast.com**

There are some chassis that hide fans discreetly away. Not so the Hyte Y40, which places them front, centre, top and side. As these are all addressable RGB fans, you can create quite the light show to show them off. And tempered glass panels at both the side and the front mean they can be admired from all angles.

Hyte describes the Y40 as "S-Tier", suggesting that it's right at the top of the quality pyramid. It's certainly different, with the graphics card sitting parallel to the motherboard thanks to a riser card. This is meant to help with airflow, with a hidden fan sitting underneath the card for extra cooling, but also means the graphics card sits proudly at the front of the chassis.

That hidden fan sits where you would normally find a hard disk caddy, but Hyte cleverly allows you to mount a 3.5in hard disk behind the motherboard. Or you can add a pair of 2.5in drives. It's a superb case to work in, too, with both sides removable without needing to unscrew a thing.

Gigabyte's clunky RGB Fusion software takes control of lighting effects, while its System Information Viewer software controls fan speeds. Despite my best efforts, however, fan noise was always audible; I wouldn't call The Krave loud, but it isn't the best choice for those who like to sit in tranquillity.

A Ryzen 7 5700X3D sits beneath a liquid cooler. AMD launched this chip in January, primarily as an affordable upgrade for gamers with existing AM4 motherboards. It's effectively a Ryzen 7 5700X except with an extra L3 memory chiplet to help out in games, but with eight cores and 16 threads it's a capable performer elsewhere, too.

Well, pretty capable. Because it uses AMD's Zen 3 architecture, not the latest Zen 4 found in AMD's 7000 series chips, its single-core Geekbench result of 1,963 now looks modest – as does 10,529 in the multicore section. Compare that to the 2,705 and 15,147 of the Ryzen 7 7800X3D found inside Cyberpower's Ultra R77 RTX Gaming PC (*see issue 356, p60*).

The plus side of Chillblast's CPU choice is that it uses DDR4 rather than DDR5 memory. This PC packs a generous 32GB via two 16GB Kingston Fury Beast RGB DIMMs, with space for a further two DIMMs (although it will be tight) on the Gigabyte B550 Aorus Elite AX V2 motherboard.

There are two M.2 slots available, too, although the second one only supports PCI-E Gen 3 rather than Gen 4 speeds. The supplied Crucial P3 Plus SSD isn't the fastest around, hitting 4,045MB/sec reads and 3,111MB/sec writes in CrystalDiskMark, but it makes up for this with a 2TB capacity.

All of which leads up to the star of the show: a GeForce RTX 4060 Ti card. Chillblast supplied my review PC with a 16GB Asus GeForce RTX 4060 Ti Dual 16GB OC, but I would save £129 and choose the more usual 8GB version. This makes minimal difference at most settings, with the key bottleneck being the card's 128-bit memory bandwidth rather than the actual amount of memory.

If you're looking for triple-figure frame rates, then 1440p High settings are your friend. Here, it scored 100fps in *Assassin's Creed: Valhalla*, 126fps in *Dirt 5*, 130fps in *Cyberpunk 2077* and 187fps in *Shadow of the Tomb Raider*. It only struggled in *Metro Exodus Enhanced*, with a 60fps result. Switching to 4K and High settings, it returned 57fps, 74fps, 51fps, 106fps and 45fps in those five games respectively.

Want a true 4K gaming rig? You can upgrade the card to a 4070 for £249 and a 4070 Ti for £471, but at that point you're edging closer to the £2,299 Cyberpower Ultra R77 – complete with a Ryzen 7 78003XD and RTX 4080 Super. If your budget stretches to anything beginning with "2", that's the PC to opt for.

Nevertheless, I like The Karve. It's a bold choice of name to match a bold choice of chassis, and Chillblast has clearly paid attention to this build; not only to the cable management, but the arrangement of the fans to create maximum effect. It falls short of a Recommended award due to the older CPU architecture, but if you only care about gaming then it's a great advert for the RTX 4060 Ti. **TIM DANTON**

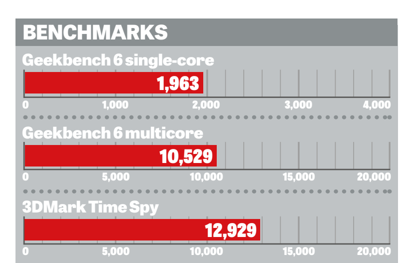
ABOVE The distinctive Hyte Y40 chassis puts the fans and graphics card on full display

"It's certainly different, with the graphics card sitting parallel to the motherboard thanks to a riser card"

LEFT There's plenty of space inside the case for upgrades

BELOW A hidden fan beneath the graphics card helps with cooling







SPECIFICATIONS

8-core/16-thread AMD Ryzen 7 5700X3D processor • Gigabyte B550 Aorus Elite AX V2 motherboard • 32GB DDR4-3200 Kingston Fury Beast RGB RAM • 8GB Asus GeForce RTX 4060 Ti graphics • CIT Pro Glacier liquid cooler • 2TB Crucial P3 Plus PCI-E Gen4 SSD • Hyte Y40 White chassis • 750W Corsair RME Series PSU • Windows 11 Home • 287 x 415 x 435mm (WDH) • 2yr parts and labour C&R warranty (5yr labour-only RTB) • power, 70W idle, 303W peak

How we test

Laptops and PCs

We run a selection of benchmarks on all the PCs and laptops we test. Where possible, we use a cross-platform test so we can compare Windows and macOS machines, which is where both Geekbench and Cinebench R23 come into play. Both push the CPU to its limit, exposing how well cooled a system is.

We run extra tests for Windows systems. We use PCMark 10 to benchmark systems in office tasks, content creation and basic tasks such as web browsing and video calls. We also run 3DMark Time Spy and *Shadow of the Tomb Raider* as a minimum. We test laptops and PCs that include discrete graphics with a range of games, such as *Metro Exodus Enhanced* and *Dirt 5*.

For laptops, we test battery life with Wi-Fi on and the screen brightness set to 150cd/m². We fully charge the laptops and drain them until they reach 5%. For Windows laptops, we will use a mix of PCMark 10's light-use and video-based tests, or a web surfing benchmark where a laptop automatically visits sites until the battery dies. We also use this test for MacBooks.

ABOVE We put PCs and laptops through our intensive set of benchmarks

Screen quality

In each laptop, phone, tablet and monitor review, you'll see our conclusions about the screen quality. Some of this will be subjective, but we also test each screen using a X-Rite Display i1 Plus colorimeter. We measure maximum brightness, colour accuracy and (for monitors) consistency – there may be a difference in, say, brightness from the middle and the edges of the panel.

We also measure Delta E, which is a guide to how accurately panels display colours. Anything under 1 is excellent and likely to be difficult for the human eye to distinguish; between one and two is still strong; above this suggests a panel that you shouldn't trust for colour-accurate photo editing.

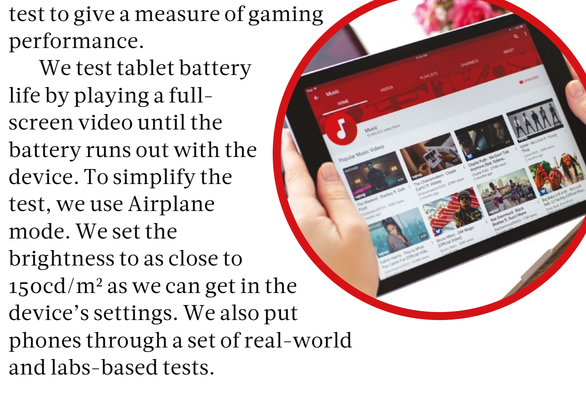
LEFT We use a Display i1 colorimeter to measure sRGB gamut coverage and Delta E

Phones and tablets

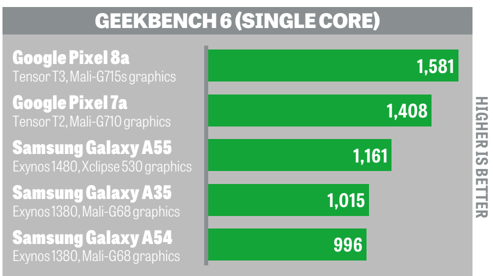
We run a selection of publicly available benchmarks on all the phones and tablets we review. First, we run Geekbench 6. This is a good test of the processor and memory in particular, and include both a test for single-core and multicore performance. See below for a selection of scores to provide a reference of what's good… and what's not so good.

We also run 3DMark Wild Life test to give a measure of gaming performance.

We test tablet battery life by playing a full-screen video until the battery runs out with the device. To simplify the test, we use Airplane mode. We set the brightness to as close to 150cd/m² as we can get in the device's settings. We also put phones through a set of real-world and labs-based tests.



BELOW We play a video with the screen set to 150cd/m² to test battery life



What our awards mean



Recommended

This, quite simply, is a product we recommend you buy – if it meets your needs.



A-List

The best buy in its category right now. The product will also feature on our A-List, starting on p14. It's updated each month.



Labs Winner

Each month we run a group test, or Labs. This product has managed to beat all others to top position.

The pcpro.link

Throughout the magazine you'll see pcpro.link shortcuts. Enter these into the address bar of your browser and it will take you to a particular page, which will either be too long or awkward for us to publish or will take you to the precise shop from which to buy. If it's Amazon, note that we have an affiliate deal in place so we will receive a commission from each sale. This will never affect our verdict of a product, and if another reputable vendor is selling the product cheaper then we will use that instead.

Prices will vary

Prices we publish are correct on the day we publish, but we often see prices change, especially on sites such as Amazon. However, we do work with British PC retailers to ensure the prices we quote for their systems are correct. If the price isn't being honoured, contact us via letters@pcpro.co.uk.



Panasonic Toughbook 55 MK3

Other than the price, it's tough to find anything to criticise about this speedy and rugged 14in laptop

SCORE ★★★★☆

PRICE **As reviewed, £3,715 (£4,458 inc VAT) from ultima-computers.co.uk**

Last year I put the fully rugged Toughbook 40 (*see issue 348, p54*) through its paces, and in many ways it's the closest rival to the rugged Toughbook 55 MK3. There's a reason I didn't put "fully": while the Toughbook 40 has an IP66 rating, the 55 makes do with mere IP53.

The "5" means dust can still get inside but shouldn't interfere with its workings. The "6" of its sibling means it's fully protected, with no way for dust to get in. Arguably more telling is the water ingress rating of "3" versus "6", which translates into protection against water spray (up to 60° from the vertical) as opposed to protection against high-pressure water jets. So while the Toughbook 55 could still be rolled out in extreme environments, it's safer to choose the Toughbook 40.

I may be reading too much into this, but I noticed that Panasonic's promotional photos for the 55 place the laptop inside a battlefield tent rather than outside (often in the desert) as it does for the Toughbook 40.

Rugged vs fully rugged

IP ratings are only one aspect of a laptop's ruggedness. This laptop has also been put through all of the MIL-STD 810H and IEC 60529 tests for humidity, vibrations and altitude, so there are few environments where it won't carry on working. That includes extreme temperatures, being able to "comfortably operate" (to quote Panasonic) from -29°C to +60°C. Plus that vibration testing means it can easily cope with the G-forces of high-speed chases in police cars, with specially designed docking stations available to keep it secure.

The Toughbook 55 can also withstand 26 drops from a height of three feet, but the Toughbook 40 goes further still having been certified to survive drops from six feet.

Mobile powerhouse

The plus side to this comparative lack of battlewear is portability. With two batteries inside, the Toughbook 55 weighs 2.8kg compared to over 4kg for the 40, and it lasted a remarkable 21hrs 13mins in PCMark's video-rundown test. That's two hours shy of its stablemate, but in reality I suspect they'd deliver almost identical results. Both batteries have the same 68Wh capacity, so switch to one and you can expect roughly half that time.

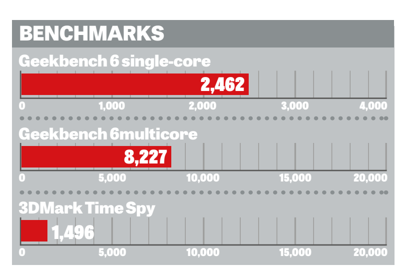
As with all Toughbooks, there's no need for a bag when on the move. The honeycombed design on the metal lid is there to give extra protection from bashes, and the integrated handle is a great way to carry it around on jobs.

It ships with a DC charger, which is slim but weighs 500g once you add the cables, and for £216 exc VAT you can buy car chargers, too, or even a four-bay battery charger for £290. Sit this in the passenger seat, take advantage of its 4G connection (via the Qualcomm Snapdragon X16 LTE-A chipset) and you have always-on connectivity in its truest possible meaning. You may also want to buy a vehicle docking station, with prices from £776. There are no shortage of optional extras here.

This laptop is far more "with it" than the Toughbook 40 in terms of connectivity, starting with the Wi-Fi 6E radio. You also have full control

ABOVE **The Toughbook 55 MK3 has plenty of processing power inside its rugged case**

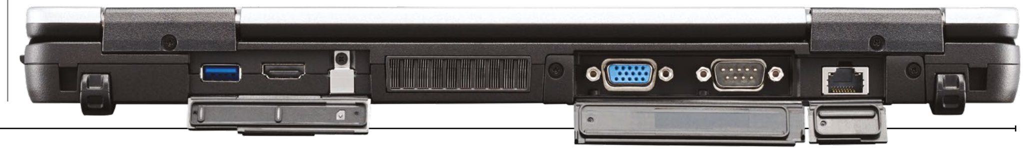
"You have full control over what physical ports are included, with three areas where you can swap out the screw-in modules"



BATTERY LIFE

Light use 23hrs 1min

0 5 10 15 20 25



BELOW **You can customise the laptop's connectors with the screw-in modules**



over what physical ports are included, with three different areas where you can swap out the screw-in modules. I tested the FZ-55JT112BE model, which includes one module with a gigabit RJ45 port, D-SUB and serial port, and a second that offers HDMI and a USB-A 3.2 Gen 1 port. The right-hand side has another unit packing another RJ45 and USB-A port, plus a Thunderbolt 4/USB-C 4 connection. You can buy more and swap them as required.

The customisability doesn't end there, with two front expansion areas ready for your choice of batteries, fingerprint readers or smart card readers. There's also a third hot-swap expansion bay on the left. In my case, this included a smart card reader, but other options include second SSDs, a DVD writer and a Blu-ray drive.

Power on tap

There's one more big difference between the Toughbook 55 and the 40, and that's speed. The 40 was released in 2022, and it's stuck with Intel's 11th gen chips. Here, Panasonic takes advantage of 13th gen Core CPUs, which may lack the neural processing unit of the latest Intel silicon but are still superb performers – partly thanks to numerous cores, which are a mix of Performance and Efficiency cores.

You can specify the Toughbook 55 with either a Core i5-1345U or i7-1370P and 16GB or 32GB of RAM, with my unit packing the top-end specs (including a 1TB SSD). The memory is supplied as a single DIMM, so you can double it easily, with one crosshead screw and a covering flap standing in your way.

It was no surprise to see it whip the Toughbook 40 in every test I ran. In Geekbench 6, the 40 managed 1,842 in the single-core and 5,118 in the multicore tests, while the 55 returned 2,462 and 8,227. It was a similar story in Cinebench R23, with 1,394 and 5,273 compared to 1,889 and 10,319. The phrase "night and day" springs to mind.

There's only one 14in rival for speed and ruggedness, which is Getac's S410 Pro. I haven't yet reviewed it, but its main performance advantage over the new Toughbook is that it offers an option with GeForce GTX 1650 graphics. To give an idea of their comparative power, I'd expect a GTX 1650-powered laptop to score around 4,000 in 3DMark's Time spy compared to the Toughbook 55's 1,496.

Screen power

Rather than trying to impress with a high resolution, rugged laptops want to impress with high brightness. Here, the Toughbook 55 reached 980cd/m² at its peak, and with an anti-glare, anti-reflection covering I found it incredibly easy to view under the full glare of the sun. At the other extreme, you can reduce the brightness to almost zero – useful for covert military operations. Visibility is boosted by a contrast ratio of 1,703:1, too.

This isn't a panel designed for colour accuracy or coverage, as reflected by an average Delta E of 4.58 and only 58% of the sRGB gamut. Nor is it meant for movie fans, with 41% of the DCI-P3 colour space on show. Despite this, in isolation colours look fine; it's only when you place it next to an OLED laptop such as the Huawei MateBook X Pro (*see p60*) that it pales.

It's a touchscreen, of course, with support for fingers and styluses, but unlike the Toughbook 40 Panasonic doesn't recommend you use it in the rain. There's a stylus garaged within the chassis with a built-in loop in case you're worried about losing it, and while it's relatively short at 12cm it's thick enough to hold wearing gloves.

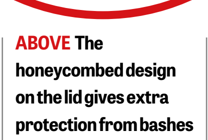
One final note: my tested unit was the Full HD (1,920 x 1,080) panel, but you can save money by choosing the HD version with a 1,366 x 768 screen. HD models start at £1,675 exc VAT versus £2,115 exc VAT, so a decent saving, but I know which I'd choose.

Extra security

Aware that many of its customers handle secure data, the Toughbook 55 comes with a heap of software and hardware features to add extra layers of defence. For example, rather than store data on the internal SSD, it may be safer to keep it on an encrypted second drive that can be removed. Useful when sending the laptop back for repair, as it means your data isn't at risk.

The processors are from Intel's vPro family, too, which not only means easier remote management but also hardware-based security enhancements. In particular, Intel's Threat Detection Technology can use telemetry at the CPU level to spot ransomware and zero-day attacks. In addition, Toughbooks are part of Microsoft's Secured-core PC scheme, giving yet another layer of reassurance. Naturally you get on-laptop security too, with our model featuring face recognition via the pretty decent 1080p webcam.

One final extra is the option of an emergency notification if Panasonic thinks "your safety or your property may be jeopardised because of your computer". For example, if an insecure driver is installed or a battery has been recalled then a nag screen will appear.



ABOVE The honeycombed design on the lid gives extra protection from bashes

On the lap

My final word goes to the keyboard, which I actually fell a little in love with. The keys have deep travel with enough cushioning to make them enjoyable to hit for long periods, they're well delineated (the cursor keys have their own separate area) and the only potential hiccup is a single-height Enter key. For some reason the red F11 button, programmable to your needs, particularly appeals to me.

I also like the fact that I can spill coffee on this machine with impunity, but it's perhaps more pertinent to its target markets that you can wipe it after use to ensure it's germ-free. One note: if you can afford it, make sure you choose the backlit keyboard as that will make it much easier to use in dark conditions. Unusually, you get four brightness levels.

> "The Toughbook 55 comes with a heap of software and hardware features to add extra layers of defence"

I definitely didn't fall in love with the tiny 85 x 45mm touchpad, but Panasonic makes left- and right-clicks easy thanks to the physical buttons sitting below it.

So I have some minor grumbles, but they don't put me off this rugged – as opposed to fully rugged – laptop. It's light enough to be truly portable, its battery life is excellent, it's customisable to the nth degree, it's easy to repair, and considering what you're getting it's also fairly priced.

You'll already know if you need a rugged laptop. Of all the models I've tested, this is my pick.

TIM DANTON



BELOW The screen is easy to see in bright conditions, and the keyboard is excellent

SPECIFICATIONS

14-core (6 P-cores, 8 E-cores) Intel Core i7-1370P vPro processor • Intel UHD graphics • 32GB DDR4-3200 RAM • 14in 60Hz IPS touchscreen, 1,920 x 1,080 resolution • 1TB M.2 PCI-E Gen4 SSD • Wi-Fi 6E • Bluetooth 5.3 • 4G • GPS • 1080p IR webcam • Thunderbolt 4/USB-C 4 • 2 x USB-A 3.2 Gen 1 • HDMI • D-SUB • serial port • 2 x gigabit Ethernet • microSD card reader • smart card reader • 2 x 68Wh batteries • Windows 11 Pro • 345 x 272 x 32.8mm (WDH) • 2.8kg • 3yr limited warranty • part code FZ-55JT112BE

Lenovo X1 Carbon Gen 12

If you're hunting for a powerful, lightweight executive laptop, this should be at the top of your list

SCORE ★★★★★

PRICE As reviewed, £1,583 (£1,899 inc VAT) from lenovo.com/uk



When you reach the 12th generation of any product, you can't expect revolutionary changes. Nor did I want any, with the 11th gen Lenovo X1 Carbon (*see issue 350, p85*) winning our most recent business laptops Labs due to its mix of light design, build quality and brilliant ergonomics. By which I primarily mean a keyboard that still beats all-comers.

The biggest change as the X1 Carbon turns 12 comes via Intel's Core Ultra processors. Lenovo offers a range of six, from the Core Ultra 5 125U to the Ultra 7 155H, and two of those six are vPro chips. My test system included the relatively modest Core Ultra 5 135U vPro, and with 12 cores (only two of which are performance P-cores) I didn't expect it to blast through the benchmarks. That certainly held true in 3DMark. But, with 32GB of RAM by its side, it nudged close to five figures in both Geekbench 6 and Cinebench R23's multicore tests – and you can choose a 16-core Ultra 7 chip if you need more.

A top-quality SSD in tow helps, with a 512GB "Performance" Opal 2.0 drive returning sequential reads of 6,680MB/sec and writes of 4,773MB/sec in CrystalDiskMark 8. I'd prefer a 1TB drive (a £40 upgrade if you choose the Performance version) or 2TB (£135), but you can always add fast external storage via the pair of Thunderbolt 4/USB-C 4 ports on the left. The USB-A 3.2 Gen 1 ports – one on the left, one on the right – are stuck at 5Gbits/sec but remain useful, and I also appreciate the HDMI and 3.5mm jack.

There's no RJ45 port or Wi-Fi 7, but Intel's AX211 radio ticks the Wi-Fi 6E and Bluetooth 5.3 boxes. You can add mobile broadband, too: a 4G card costs £110, 5G £170. But be careful using Lenovo's "build your PC" configurator, because a laptop that starts at £1,375 exc VAT soon doubles in price.

Take the 14in screen. The most basic one, which I tested, is a matte IPS non-touch panel designed for power efficiency rather than eye-popping colour. It still covers 98% of the sRGB gamut and 73% of the DCI-P3 space, and its quality is evidenced by a 1,702:1 contrast ratio and average Delta E of 0.27, so colour accuracy is excellent. But with a 1,920 x 1,200 resolution it sometimes feels cramped. I would spend the extra £180 on the OLED panel, as that's 120Hz, promises 100% coverage of DCI-P3, supports touch and has a 2,880 x 1,800 resolution.

But it will eat away at the battery, and with the screen set at 150cd/m² I typically saw between ten and 11 hours of life in tests with my setup. That's okay – good, even – but I would expect those figures to drop to eight to nine hours with an OLED panel. Fortunately, using the slim 65W power supply, half an hour's charge brought it back up to 48%.

ABOVE The latest X1 Carbon laptops are endowed with Intel's Core Ultra processors

LEFT The build quality is up to Lenovo's usual high standards

BELOW There's a decent selection of ports along the the sides of the chassis

Battery performance inevitably reduces over time, so I was pleased to see it's relatively easy to replace. Only four crosshead screws stand in your way to remove the bottom of the chassis, and you'll discover the SSD, Wi-Fi and mobile broadband units are similarly easy to replace. Sadly the memory is embedded onto the motherboard, with no spare sockets available.

You can upgrade to a haptic touchpad for £40, but the glass-coated pad supplied is extremely responsive. It's wide if relatively shallow at 120 x 70mm, while a trackpoint is in place above it, but as ever with ThinkPads it's the keyboard that's the star. This lived up to my high expectations, with deep travel, cushioned keys and attention to detail, including the contoured shape of the keys that almost hug your fingers as you type.

Lenovo gets other little things right too. At the same time as making the webcam housing fractionally bigger so it's easier to lift the lid single-handed, it's also upped the quality of the webcam itself – helped along by the NPU in the Core Ultra chips to handle background blurs. Lenovo provides its own bag of effects via a separate app, and it's worth exploring the options available in the supplied software. For example, Vantage remains a superb choice for customising ThinkPad settings.

> **"The keyboard lived up to my high expectations, with deep travel, cushioned keys and attention to detail, including contoured keys"**

The microphones – whether aided by AI to reduce background noise or not – did a superb job of capturing my voice, and I was similarly happy with the speakers. Solid bass and excellent detail means it almost matches the dizzy heights of the Huawei MateBook X Pro (*see p60*).

Then again, you should expect this sort of quality when paying a premium for a business laptop. In return you're buying an incredibly light, well-built machine with plenty of power and enough battery to last from Heathrow to LA. Specify wisely and you'll buy a machine that will last you well beyond the three years of the on-site warranty. **TIM DANTON**

BENCHMARKS

Benchmark	Score
Geekbench 6 single-core	2,192
Geekbench 6 multicore	9,616
3DMark Time Spy	2,167

BATTERY LIFE

Test	Result
Light use	10hrs 14mins

SPECIFICATIONS

12-core (2 P-cores, 8 E-cores, 2 LPE-cores) Intel Core Ultra 5 135U vPro processor • Intel Arc graphics • 32GB LPDDR5X-6400 RAM • 14.2in 60Hz IPS non-touch panel, 1,920 x 1,200 resolution • 512GB M.2 PCI-E Gen4 SSD • Wi-Fi 6E • Bluetooth 5.3 • 1080p IR webcam • HDMI • 2 x Thunderbolt 4/USB-C 4 • 2 x USB-A 3.2 Gen 1 • 3.5mm jack • 57Wh battery • Windows 11 Pro • 313 x 215 x 15mm (WDH) • 1.1kg • 3yr on-site warranty



USB-C DOCK

USB C DOCK
65W
DISPLAY PORT
USB HUB
RJ45
POWER CABLE
ETHERNET CABLE
USB-C CABLE

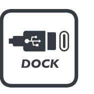
DESKTOP MONITORS

SIMPLIFY YOUR WORKSPACE WITH THE INTEGRATED USB-C DOCK

The USB-C dock on the iiyama XUB2797QSN-B1 simplifies your workspace by using a single cable to display content and charge your laptop. With additional USB-ports, your wireless mouse and keyboard or webcam can also be connected to the monitor for seamless plug and display solution. The added benefit of the high resolution 2560x1440 IPS LCD display makes all the difference for image clarity and productivity, boosted further with the ability to connect to a secondary display for a power multi-display workspace.



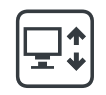








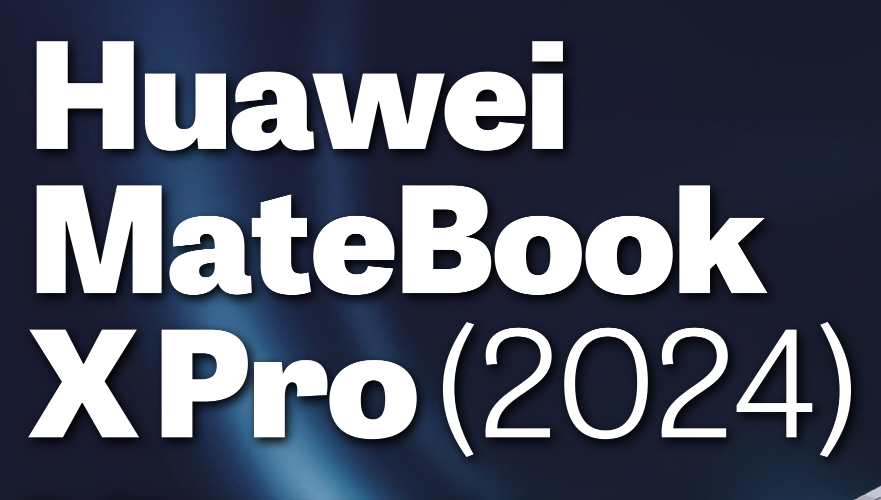










Huawei MateBook X Pro (2024)

This 980g laptop is stunningly slim, attractive and packed with power – it's worth the undoubted expense

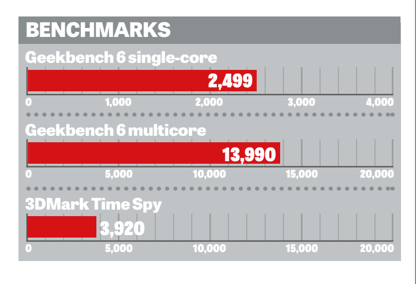
SCORE ★★★★★

PRICE £1,750 (£2,100 inc VAT) from consumer.huawei.com

We overuse the term "flagship", but when I say that the MateBook X Pro is Huawei's flagship laptop I do so with due care. When Huawei creates a new version each year, it goes to great lengths to pack the latest tech into the lightest possible chassis. And while that has always been true, this year's offering is the best I've tested by some length.

Take the speakers. Normally I grade these on whether they're good enough for listening to music, but I was genuinely surprised by the sound emanating from this tiny machine. Somehow, Huawei has shaped the audio to make it sound like there's a pair of high-quality standalone speakers to either side of you. Whichever genre I listened to, the MateBook X Pro handled it with skill.

I start this review with the speakers to emphasise the attention to detail that Huawei has paid to every aspect of this laptop, but what you'll first notice is its slimness. If Steve Jobs were still alive I'm certain he'd be reaching for a manilla envelope to pull it from. But the MateBook X Pro's most headline-grabbing feature is its weight. Huawei states 980g and my scales went further, declaring at 978g. It's one of those laptops that you lift up and wonder how the designers managed it.



Design secrets

The body is made from a "robust form of aluminium" that, according to Huawei, is 40% stronger than traditional versions. It has saved space by switching to a three-segment printed circuit board (PCB) design rather than the normal one- or two-segment offerings. It reckons this means the PCB takes up 8% less space than last year's X Pro, which it has used to increase the size of the speakers, battery and fans.

It's a CNC unibody design, which means the aluminium shell is cut and moulded in one process. Here, it's coated with a powder blue matte finish that Huawei calls Morandi blue. It's almost chalk-like in its feel, with a roughness that's genuinely nice to hold. I was worried about fingerprints, but unless you look at it in a certain light they aren't visible. All told, it not only looks terrific but strikingly unique.

ABOVE The MateBook X Pro is a stunningly engineered laptop



There's a minimalist feel to it that also appeals. My review sample only included one badge on the top – Intel's black Evo sticker – while the bottom of the chassis is clean. Aside from a peelable sticker, all you'll find are four rounded, rubber feet.

Right to repair?

Those feet do their primary job well, but they're a nightmare for potential repairers. Huawei had already entered my bad books for using Torx screws (T5) rather than normal crossheads, but it is on the naughty step for hiding a further two under the rubber bumpers, which proved so tightly bound that I couldn't remove them. Fortunately I could still unclip one edge of the base to peer inside, confirming that the 32GB of RAM was soldered on but the battery and 2TB SSD were replaceable.

> "What you'll first notice is its slimness. If Steve Jobs were still alive I'm certain he'd be reaching for a manilla envelope to pull it out from"

It also gave me a glimpse at the pair of fans Huawei has squeezed inside to keep the Core Ultra 9 185H processor cool, with the promise of up to 40W of power to push it that little bit further. This is only the second laptop I've tested with this chip inside, following the Asus Vivobook Pro 15 OLED (*see issue 357, p60*) last month. To see how

BELOW With such a slim chassis, ports are limited to one USB-C 3.2 and two USB-C 4



effective Huawei's implementation was, I turned to Geekbench 6, which focuses on the CPU.

And it's fair to say that Huawei has reasons to gloat. Not so much for the single-core results, where it was level pegging, but in the multicore tests where it managed 13,990 to its rival's 12,741. I also tested both machines in PCMark 10, where the Huawei scored 7,289 and the Asus 6,784.

Despite this power, the MateBook X Pro has battery life to burn. Its 70Wh unit lasted for 11hrs 18mins in the PCMark Modern Office test, 12hrs 13mins when playing a 1080p video and 15hrs 45mins when left idling.

The thicker and heavier Vivobook had the advantage for gaming thanks to GeForce RTX 4060 graphics while Huawei relies on Intel's integrated Arc GPU. It will be fine for less demanding games, but *Shadow of the Tomb Raider* only reached a slickish 51fps when I switched on the Lowest settings at 1080p; at its Highest settings, that dropped to 29fps. Those hoping to game at the screen's native 3,120 x 2,080 resolution should note those rates fell to 30fps and 14fps.

Super screen

This brings us to yet another highlight: a 14.2in OLED panel. With a 120Hz refresh rate – dynamic rather than adaptive, so it will switch between 60Hz and 120Hz depending on the task – older games look fantastic. And while there's no DisplayHDR certification, Huawei claims it reaches a peak of 1,000cd/m² when viewing HDR content. Films and TV shows that take advantage looked as good as they sounded.

I ran the panel through our tests and found it impossible to fault. It peaked at 587cd/m² with SDR content and covered a superb 97% of the DCI-P3 gamut with an average Delta E of 0.43. Even print designers might be tempted by its 87% Adobe RGB coverage, which is far more than most laptop panels. This was with its "Pro Colour" mode activated; turn this off and it switches to an uncalibrated native profile, which I don't recommend.

Pro Colour is on by default, tucked away in Huawei's Control Panel. You find this by launching Huawei PC Manager, and I recommend anyone who buys a Huawei laptop spends 15 minutes playing around here. If you own a Huawei phone or tablet, this is also where you can use Super Share to drag and drop files between devices.

Super touch

PC Manager is where you can learn about your haptic touchpad's secret powers, too. For example, slide a finger up the left hand side to control the brightness; the right-hand side for volume. Double-clicking with one knuckle takes a screenshot while a two-knuckle tap starts screen recording. You can also fast-forward through videos by swiping a finger along the top of the touchpad, while tapping the top left minimises an active window and the top right closes it. All very clever.

On occasion, however, I found the touchpad too clever for its own good. It's so responsive that I sometimes touched it inadvertently and milliseconds later found that a chunk of text had moved from one section of my open document to another.

Huawei claims the keys have 1.5mm of travel, but don't be fooled into thinking that this is a typist's dream. This is one area where Huawei still falls behind Dell's and Lenovo's premium machines. But it's still pleasant to type on, with a quiet action and well-separated keys, while the two-level backlight shines through the keys to make it easy to see exactly what you're hitting.

ABOVE The minimalist design means the MateBook looks as good as it performs



ABOVE We tested with a US keyboard, but the UK version includes a double-height Enter key

All the extras

I'm no longer wowed by good webcams on laptops, especially when the CPU includes a neural processing unit (NPU) to help with effects such as blurring, but Huawei deserves special praise for cramming a high-quality webcam into such a tiny bezel. It's matched by an equally excellent pair of microphones to capture your voice, with the promise that it will use AI to reduce background din in cafés. And it does so, without applying horrific echo to the captured voice.

We've come a long way from the days when Huawei stuffed a rubbish webcam beneath a function key, but it still provides a nod to security by including a physical switch on the right-hand side of the chassis to deactivate the camera (but not the mics).

That's also where you'll find a USB-C 3.2 Gen 2 port. That's fine for charging and even display outputs, but if you want maximum data transfer speeds then head over to the left where you'll find two Thunderbolt 4/USB-C 4 ports. Those hoping for 3.5mm jacks, HDMI outputs or a USB-A port will be disappointed, but Huawei bundles a USB-C to USB-A converter to soften the blow.

"With so much power and so much attention paid to build quality I would expect this laptop to provide many years of excellent service"

At this price I hoped for a USB-C hub that would add USB-A, HDMI and RJ45 ports, and was also disappointed to see Wi-Fi 6E rather than Wi-Fi 7. Especially as Huawei has gone to great efforts to improve antenna performance; it claims this laptop has a range of 330m in open environments, and it connected to routers at far greater distance than others I've tested.

If the price is right

When you're getting so much quality and power it's hard to argue with the price. The question is whether you need it; if you can cope with a 1.3kg weight then the Huawei MateBook 14 (*see p62*) is a compelling alternative for almost half the outlay.

There are no lesser specs you can choose to reduce the price, with Huawei only selling this specification in the UK. You should also factor in extra to extend the warranty, with a lowly single year of cover coming as standard. Sometimes, though, Huawei offers a cut-rate deal for an extended warranty, so that's worth checking when it goes on sale on 18 June, with pre-orders starting 4 June.

The warranty may be basic, but with so much power and so much attention paid to build quality I would expect this laptop to provide many years of excellent service. If you have the budget, buy it. **TIM DANTON**

SPECIFICATIONS

16-core (6 P-cores, 8 E-cores, 2 LPE-cores) Intel Core Ultra 9 185H processor • Intel Arc graphics • 32GB LPDDR5X-7467 RAM • 14.2in 120Hz OLED touchscreen, 3,120 x 2,080 resolution • 2TB M.2 PCI-E Gen4 SSD • Wi-Fi 6E • Bluetooth 5.3 • 1080p IR webcam • 2 x Thunderbolt 4/USB-C 4 • USB-C 3.2 Gen 2 • 70Wh battery • Windows 11 Home • 310 x 222 x 13.5mm (WDH) • 980g • 1yr RTB warranty



Huawei MateBook 14 (2024)

The X Pro's more pragmatic sibling, the MateBook 14 delivers for speed, battery life and value

SCORE ★★★★★

PRICE £1,000 (£1,200 inc VAT) **from consumer.huawei.com**

If your budget can't stretch to £2,100 for the MateBook X 14 Pro (*see p60*), there are many reasons to be tempted by its cheaper sibling. It's still sleek at 14.5mm, it still includes one of Intel's most recent Core Ultra chips, and it still packs a high-quality 14.2in OLED touchscreen. It just lacks luxury by comparison: the metal chassis looks and feels less expensive, for example, although the new pastel green finish ensures it stands out from the grey crowd.

At 1.3kg the MateBook 14 is much heftier than the X Pro but remains a great choice for mobile workers thanks to a 70Wh battery, which kept it going for 16hrs 55mins in PCMark's idle tests. That dropped to 14hrs 50mins in the video-rundown test, so I was surprised to see it only last 9hrs 39mins in the light-use Modern Office benchmark. Then again, that's still longer than most people's working day, while the 200g power supply can top it up to 41% after 30 minutes.

There's a Core Ultra 7 rather than Core Ultra 9 inside, but I doubt many people could spot the difference in practice. While this MateBook was slower in multicore tests than its sibling, a 12,729 return in Geekbench 6 remains excellent, as is 14,613 in Cinebench R23. Two years ago only the most powerful PCs broke the 7,000 mark in PCMark 10; the MateBook 14 returned 7,162.

It achieves all this with 16GB of RAM and Intel's Arc graphics, which pushed it to 48fps in *Shadow of the Tomb Raider* at 1080p (lowest detail settings) and 30fps at the panel's 2,880 x 1,920 native resolution. This goes up to 120Hz in supported apps and offers excellent coverage: 97% of the DCI-P3 space, 85% of Adobe RGB. Whites look superb, and the only area where it's notably inferior to the X Pro is brightness, which peaked at 442cd/m². But I could still read it in sunlight and – as with the X Pro – I found the Wi-Fi 6 radio had excellent range, reaching parts of my garden that other laptops can't reach.

Huawei supplies a standard trackpad here with none of the clever haptic features of the X Pro, but with a smooth coating and 120 x 72mm area it does the job capably. There are no reasons to get excited by the keyboard – the action would benefit from more cushioning – but the backlight is effective, the keys are well separated, and a double-height Enter key is always welcome.

During setup you're encouraged to configure the fingerprint reader built into the power button, and this worked seamlessly in my tests. With no infrared sensors you can't use the 1080p webcam for Windows Hello logins, but it's a capable performer for web calls. It's not up to the quality of the MateBook X Pro, however, and oddly Huawei wants you to use its AI-enhanced effects rather than Microsoft's. A bad move, as it produces inferior results and adds delay.

The speakers lack the subtlety and depths of the X Pro's, but they can still handle a tune. You should also be reasonably happy with the port selection, with two USB-A ports to accompany the single USB-C connector. You'll need that to charge the MateBook 14, but compensation comes in the form of an HDMI port and 3.5mm jack.

The one area where it beats its brother is for ease of repair. Despite nine Torx screws, I quickly whipped off the bottom to reveal a replaceable battery and SSD. As is annoyingly common, with soldered-on memory you'll have to hope that nothing goes wrong with that or anything else embedded onto the motherboard; there's only one year of cover.

It says something about the MateBook 14 that it can stand toe to toe with its far more expensive sibling in so many areas: battery life, performance, quality of OLED. And it compares well to outside opposition, too. For example, the same-spec Asus Zenbook 14 OLED costs £1,300 – and if you buy direct from Huawei it tends to throw in extras for free or at a heavy discount. Then again, unlike Asus, Huawei offers no other specs: you can't save money by downgrading to a 512GB SSD or Core Ultra 5 as you can with the Zenbook 14.

But the main takeaway is that I haven't found a better laptop for sale at this price (it's available for pre-order on 4 June and goes on sale on 18 June). If the MateBook 14 meets your needs, it's a great choice. **TIM DANTON**

ABOVE The MateBook 14 packs lots of power and a great display



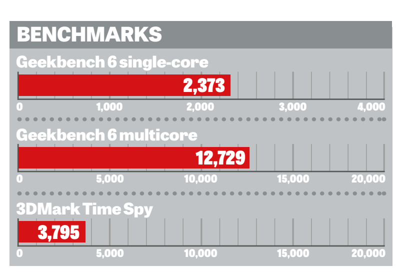
LEFT The new pastel green finish helps the MateBook 14 stand out

"It says something about the MateBook 14 that it can stand toe to toe with its far more expensive sibling in so many areas"

SPECIFICATIONS

16-core (6 P-cores, 8 E-cores, 2 LPE-cores) Intel Core Ultra 7 155H processor • Intel Arc graphics • 32GB LPDDR5X-7467 RAM • 14.2in 120Hz OLED touchscreen, 2,880 x 1,920 resolution • 1TB M.2 PCI-E Gen4 SSD • Wi-Fi 6 • Bluetooth 5.3 • 1080p webcam • HDMI • USB-C 3.2 Gen 2 • 2 x USB-A 3.2 Gen 1 • 3.5mm jack • 70Wh battery • Windows 11 Home • 313 x 227 x 14.5mm (WDH) • 1.3kg • 1yr RTB warranty

BENCHMARKS



BATTERY LIFE

Light use 9hrs 39mins

0 5 10 15 20 25



BELOW The selection of ports includes two USB-A and one USB-C



Rabbit R1

Too many bugs mean we wouldn't rush to buy this AI bunny, but there are signs that it may improve

SCORE ★★☆☆☆

PRICE No subscription, £135 (£162 inc VAT) from rabbit.tech

What if you could search the web, book a taxi, order a meal or even generate AI images just by saying a command out loud? That's the promise of the Rabbit R1, a retro chic device that literally puts AI in the palm of your hand.

It's an eye-catching gadget, with a square, neon orange design that suggests the hybrid offspring of an iPod and a Tamagotchi. It's made of cheap plastic, but what do you expect for £162? On the right side there's a push-to-talk button for addressing the Rabbit, while the front has a 2.8in touch display, a scroll wheel and a rotating camera for visual searches.

There's also a small loudspeaker on the bottom left side, while the left edge features a USB-C port for charging and a 4G SIM card slot. This lets you use the device when you're away from a Wi-Fi network, but if you don't want another data subscription you can tether it to your phone when you're on the go.

Interacting with the interface

Although the R1 has a touchscreen, the operating system barely uses it – it's mostly there for occasional text entry, such as entering a Wi-Fi password. For the most part the Rabbit relies on the scroll wheel and side button for navigating menus and selecting options. Frankly, this is frustrating: many times during my testing I instinctively tapped a button or icon on the display, only for nothing to happen. I also wish the scroll wheel was more sensitive, as dialling up and down through menu items is tiresome.

This isn't a huge everyday issue, luckily, as most of the interactions you'll have with the R1 will be via voice. And this works pretty well, with a cute onscreen rabbit that pricks up its ears while you're talking so you know the device is listening. I started my Rabbit journey by asking, "What's the weather for today?" Using its internal GPS receiver the R1 correctly detected my location, and gave me an hourly forecast for the rest of the day.

ABOVE The Rabbit R1 has a retro chic look but is powered by AI

I next tried asking how the stock market was doing, and received a quick report of the Dow Jones' status, with an option to scroll through daily, weekly and monthly views. I did note, though, that this was slow to appear – I timed 11 seconds over Wi-Fi – and it didn't present any information about other indices, such as Nasdaq or S&P.

Not all queries generate such rich responses. When I asked who had won the Yankees game last night, the R1 spoke the correct answer, and brought up the result on screen – but as bare text. On the positive side, the device was smart enough to correctly answer the follow-up question, "How many home runs did they hit?" – something Siri on my iPhone couldn't do.

Searching by image

As well as talking to the Rabbit R1, you can use its built-in camera to perform visual searches. This is gloriously simple: just double-click the button to activate the R1's eye, then push and hold the side button to ask about what you see.

Unfortunately, the responses aren't reliable. I tried pointing the R1 at my drinks cabinet at home and asked, "What kind of cocktails can I make with this?" The device correctly suggested I could make a gin and tonic using the Gordon's gin, but also recommended various cocktails using ingredients I don't have.

> **"As well as talking to the R1, you can use its built-in camera to perform visual searches. Unfortunately, the responses aren't reliable"**

It was a similar story with the plants around my home. The R1 initially misidentified a Kalanchoe plant as a primrose; on a second attempt it named it as an African violet. By contrast, Google Lens on my iPhone nailed it first time.

Perhaps the R1's most intriguing camera feature is its ability to work with spreadsheets. I took a photo of an incomplete spreadsheet and asked the Rabbit to fill in the missing numbers; almost immediately I got a ping as the requested document landed in my email inbox. Unfortunately, all the provided totals were wrong. The best I can say about the R1's imaging capabilities is that they're a mixed bag.



LEFT Visual searches using the built-in camera don't always work well



Music and voice recording

One headline feature of the Rabbit R1 is its integration with Spotify, but I found this distinctly half-baked. You can request individual tracks and albums, but not your personal playlists, which is a huge miss.

Even if that doesn't bother you, the controls are a disaster. You might assume that the scroll wheel would control the volume, but it actually skips back and forth between tracks. Incredibly, if you do want to adjust the volume you must shake the device to open the Settings menu, then navigate to the media volume settings (which are separate from voice and system controls). A better bet is to pair the R1 with a Bluetooth speaker, for more hands-on control and better audio quality.

The R1 also works as an audio recorder for meetings, with a nifty tape recorder animation as the meeting progresses. Once the meeting is done, the recording is made available online inside a virtual journal. Curiously, this came with a convenient text summary of my meeting but not a full transcription, which is something Google Meet offers.

Taxis and takeaways

Another one of the Rabbit's signature party tricks is ordering taxis. The company proudly claims that it has specifically trained its AI bots on the Uber interface, enabling it to seamlessly make a reservation on your behalf.

The first time I tried to book a ride from my home to the local Starbucks, I was prompted to speak my starting address and destination – and was then booted back to the home screen with an error message. I tried again, and this time saw a quoted price of more than £150 for a journey of just over a mile. Suffice to say, I'm going to stick to using my phone for the near future.

I also tried to see if I could order one of my favourite meals from a nearby restaurant. The good news is that the R1 recognised the name and location of the restaurant, but for some reason the menu it displayed contained only six items. And when I tried to add one of them to my cart, I got an error message asking me to try again in a few seconds. I did, and it still didn't work.

I then tried a more specific query: "order me a barbeque burger from Chapter House". This seemed to challenge the Rabbit R1, which machinated for almost a minute before coming back to me with a menu for Five Guys. I'm willing to believe that this feature works sometimes, for some people, but after a few failed attempts I felt no desire to keep trying.

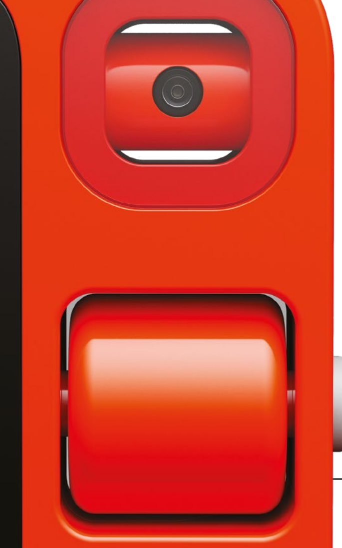
AI-generated images

By now I was feeling quite depressed about the R1, so I decided to get it to do something uplifting for me. Thanks to built-in Midjourney integration, the Rabbit can generate AI images on demand, and I asked it to make me an image of two golden retrievers playing frisbee on the beach. The Rabbit R1 processed this for about two minutes, then reported an error and gave up.

Subsequent attempts fared no better. The R1 suggested that the problem could be connected to maintenance or login issues, but I checked my connection on the Rabbit website and saw no problem. When I finally did manage to get the Rabbit to create an image for me, I was irritated to find that the system won't email it to you – you have to use a computer or phone to log in to Midjourney and access the image from there. Not for the first time, I found myself thinking I'd be better off just using a phone or computer from the outset.

ABOVE You can use the R1 as an audio recorder in meetings

ABOVE The cheap plastic finish is reminiscent of a Tamagotchi





LEFT The scroll wheel used for navigation isn't very responsive

What doesn't it do?

The Rabbit R1 isn't supposed to replace your smartphone. You can't use it to send emails or text messages, you can't set alarms or timers, and there's no way to capture your own photos or videos from the built-in camera.

While I understand the intention to keep the device focused, this seems a waste. At the very least it would be good to get live updates on the sorts of data it does provide, such as sports scores or breaking news alerts.

And considering that the Rabbit does so much less than a phone, I really would have hoped for better battery life. On most days during my testing I found that by 2pm the battery had dropped below 50%. Using the camera in particular seemed to eat up power – and if you're tethering the R1 to your phone then that will also cause your phone's battery to run down more quickly.

Run, Rabbit, run

The Rabbit R1 feels so flaky and unfinished that it seems almost unfair to pass judgment on it. But just in case you're tempted to buy it, let's be clear: I can't recommend this cute-looking gadget to anyone. While there are some cool ideas here, my time with the device was plagued by bugs, errors and inaccurate answers.

The one positive I can offer is that the Rabbit R1 ought to improve over time. During the week I spent trialling it, updates came along with improved controls for music playback, better GPS performance and other little quality-of-life enhancements. The manufacturer promises future upgrades will include interactive navigation and a teaching mode so the R1 can learn more things.

Even then, though, I don't see who needs the Rabbit R1. At the end of the day, it's an extra device you need to carry around and charge, and it does very little that you can't achieve with your phone. **MARK SPOONAUER**

SPECIFICATIONS

8-core MediaTek MT6765 processor • 4GB RAM • 128GB storage • 2.88in touchscreen • 2W speaker • Bluetooth • Wi-Fi • 4G • USB-C • 1,000mAh battery • 78 x 78 x 13mm • 115g • 1yr limited warranty

Your bonus software



We scour the globe to negotiate the best software deals for our readers, from extended licences to full programs you don't need to pay a penny for. Here's this month's lineup

AntiTrack Premium 2024

■ One-PC, one-year licence worth £50
■ avast.com
REQUIRES Windows 7 or later; 300MB hard drive space; online registration

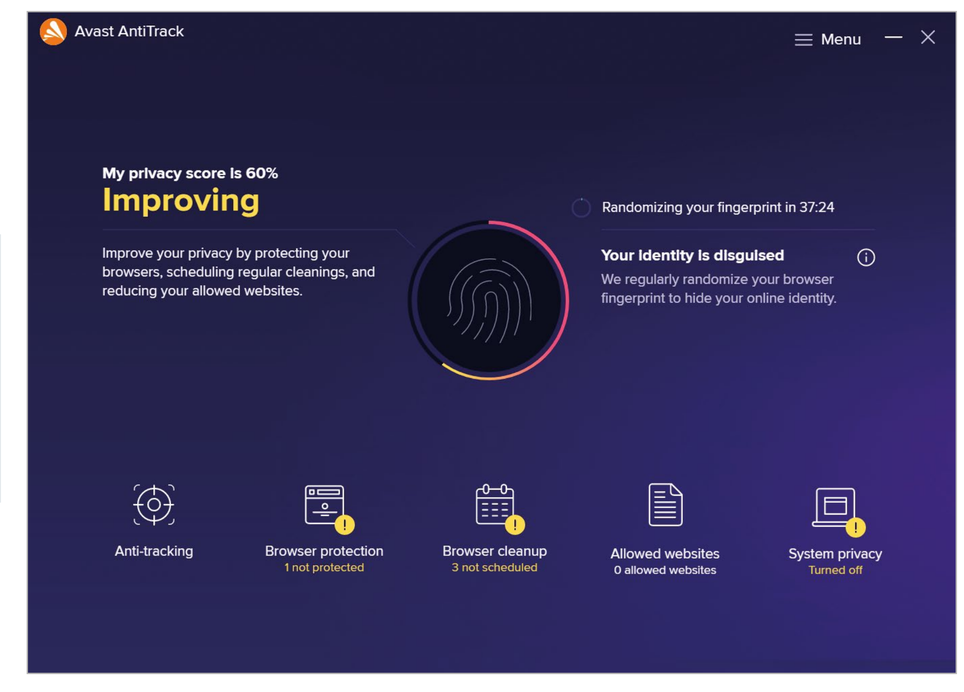
If you use the internet – for anything – then you're being tracked online. This isn't because you're special, or because companies have a particular interest in you; it's happening to everyone. Tracking enables advertisers to deliver targeted ads, and lets marketing companies know what you've bought and the sorts of things you're interested in. It also enables criminals to gather valuable information about you and your online habits, which could be exploited in a phishing attack.

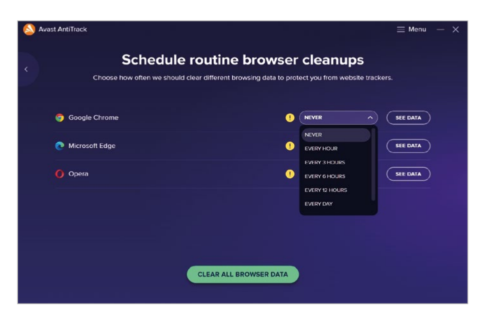
Avast AntiTrack offers you a line of defence, making it possible to stop online tracking and fingerprinting, block targeted advertising and more. The software is available for Windows, macOS and mobile platforms, and for Windows users it not only prevents online tracking but also lets you disable the tracking components that are built into the operating system.

As you browse the internet, the software automatically masks your identify and activity to make you harder to track online. It can also clear out your cookies and history, so you need have no concerns about traces being left on your computer when you're done. It works with all the most popular browsers – Chrome, Edge, Firefox, Safari and Opera – so no matter what your preference, you're probably covered.

Unlike other privacy solutions such as simple ad-blockers, Avast AntiTrack won't break websites or prevent you from accessing the content you need. When you're using the software, you're essentially made anonymous, so you can go wherever you like online and be confident that there'll be no unwanted consequences.

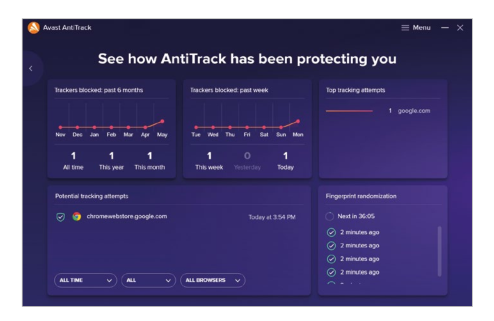
While the primary function of Avast AntiTrack is to prevent third parties from gathering information about you, it can also be used to automatically purge data stored locally on your computer, helping you to keep personal activity private from friends, family and anyone else who may have access to your computer.





ABOVE Avast AntiTrack will automatically wipe any caches and information stored by your browser, to a schedule chosen by you

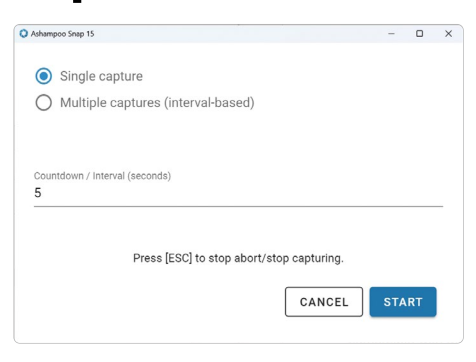
ABOVE As well as blocking online tracking technologies, you can prevent Windows and other apps from collecting information about you



ABOVE Detailed reporting lets you see exactly what the software has been doing for you, and identify potential privacy risks

Ashampoo Snap 15

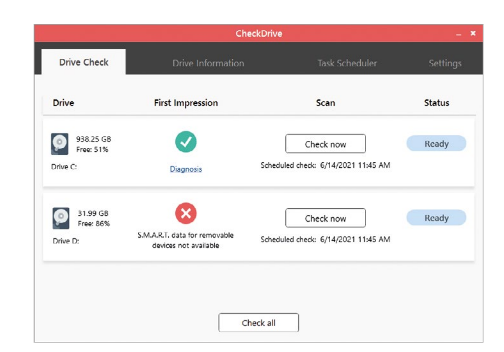
- Go beyond the standard Windows screen-grabber with this tool for capturing your desktop contents
- Capture timed shots in games, which can then be sequenced to create a video
- Works with multi-screen setups; highlight specified areas, and add shapes, text and other graphics



Full product worth £35 ashampoo.com REQUIRES Windows 7 or later; 70MB hard drive space; in-application registration

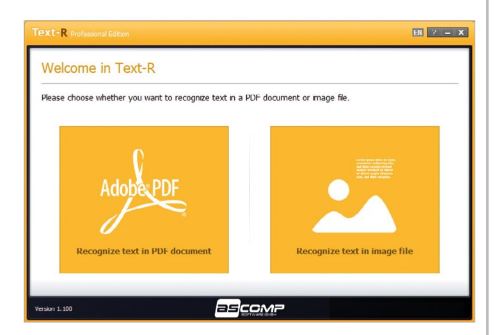
Abelssoft CheckDrive 2023

- The easy way to check your hard drive for errors, providing a friendly front end to Windows' native maintenance tool
- Reveal information about your drive, such as model, type, manufacturer, capacity and more
- Can be set to run in the background to alert you to new errors as soon as they arise



Full product worth £10 abelssoft.com REQUIRES Windows 7 or later; 75MB hard drive space; in-application registration

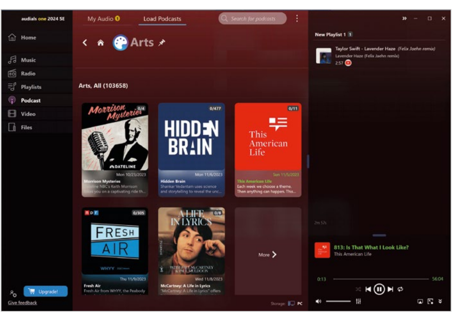
Ascomp Text-R x2.0



Full product worth £29 ascomp.de REQUIRES Windows 7 or later; 50MB hard drive space; in-application registration

- Optical character recognition tool to convert images and PDFs into editable text
- Compares recognised text to its built-in dictionary for more accurate results, with support for multiple languages
- Save your results as an editable PDF, or in plain text, XML or RTF formats

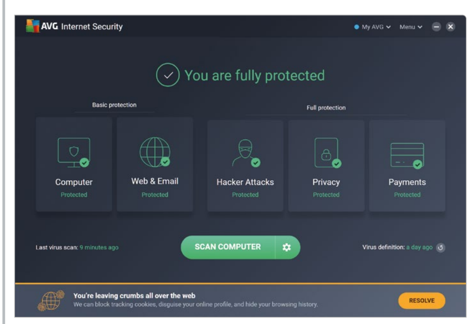
Audials One 2024.1 SE



Full product worth £15 audials.com REQUIRES Windows 10 or later; 1GB hard drive space; in-application registration

- Your one-stop-shop for all your media streaming needs – listen instantly to music, podcasts, online radio and more
- Search for specific songs, and download selected tracks in MP3 format
- Access thousands of radio stations worldwide and add your favourites to an easy access list

AVG Internet Security



One-PC, one-year licence worth £41 avg.com REQUIRES Windows 7 or later; 2GB hard drive space; online registration

- Full security suite, now with zero-day protection courtesy of Avast CyberCapture
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Acer SpatialLabs 27 View Pro

A brilliant choice for creators and developers who work in 3D, especially if they create audio landscapes



SCORE

PRICE Estimated, £2,166 (£2,599 inc VAT) from acer.com

Hot on the heels of the Lenovo ThinkVision 27 3D (*see issue 357, p48*) I reviewed last month comes Acer's spin on the same concept. Both are 27in 4K screens that can jump between 2D and 3D modes, allowing developers to view creations on demand. No need for special glasses or VR goggles; just render and go.

It's a marriage of hardware and software, and I'll tackle the hardware first. One pivotal inclusion is a pair of eye-tracking cameras; here, they sit in the top bezel rather than the bottom (Lenovo's choice), and they work equally well. The second hardware component is a 3D lens that sits above the panel and projects pixels to the left and right eyes as needed. A 3D engine built into the monitor's electronics takes control of what's beamed where.

While Lenovo includes a fine pair of speakers in the ThinkVision, they're nothing compared to the duo beneath the main body of the SpatialLabs 27 View Pro. These provide superb stereo separation in normal use, but their skills come to the fore when you activate Acer's aptly named Immerse Audio app. This plants you straight into the action, with the only missing direction being from behind you.

The 3D experience

Acer supplies an app called SpatialLabs Experience Center Professional with this monitor, and it's your direct route to activating 3D effects. The main menu offers you three options: SpatialLabs Go, SpatialLabs Model Viewer and SpatialLabs Player.

SpatialLabs Player is the simplest, as its role is simply to let you turn side-by-side videos into stereoscopic 3D. A YouTube search will bring up a bunch of example videos that have been shot at two angles – one for the left eye, one for the right – and you'll be impressed by the effects, if not the plotlines. Most of the best videos are ads.

With few movies created in 3D, SpatialLabs Go is there to turn 2D content into 3D in real-time. It's designed to work across all apps, so long as they're in full-screen view, and weirdly that includes Teams, Google Meet and Facebook. But the obvious examples are photos and videos.

I rarely found the effect compelling, but it works best when the engine can clearly detect what's up close and what's in the background. Bokeh effects are great, for example, while your shots of the Grand Canyon will look flat even if you head into the settings to maximise the 3D effect.

ABOVE The SpatialLabs 27 View Pro is a fine monitor for 2D as well as 3D work

The speakers provide superb stereo separation in normal use, but their skills come to the fore when you activate Acer's Immerse Audio app

Super models

In reality, nobody is going to buy this monitor unless they create or view 3D models for professional reasons. Acer, like Lenovo, imagines that its core audience will be architects, 3D developers and CAD designers, which is why it has created plugins for a wide range of 3D software. At the time of writing, this list consists of 3ds Max, Fusion 360, Blender, Inventor, Cura, Revit, SketchUp, Navisworks, ArchiCad, Rhino 3D, Solidworks, form Z, Zbrush, CDB and Bentley iTwin. You can also export scenes from any 3D software that includes an Unreal Datasmith exporter plugin.

You can view pre-made models directly using the SpatialLabs Model Viewer, which is effectively an



LEFT The display comes with a hood to reduce ambient light



integration with Sketchfab. Open Model Viewer and you can view a bunch of pre-selected models and manoeuvre them as if they were sitting in front of you. You can also play around with lighting and backgrounds to add to the realism.

There's especially good news for Maya users, who can use PiStage to transform their model into 3D while still being able to edit the original file in Maya. So you could work on two screens: one for editing, one for viewing. You'll need a heavyweight workstation to cope with this, though, while all the other tasks only need a moderately powerful system. For example, my ageing Surface Book with an Nvidia GTX 1650 coped fine, I just needed to wait a few seconds for processing the image.

If you want to know more, there's an excellent Q&A about the SpatialLabs 27 View Pro online at **tinyurl.com/358acerfaq**, while the user guide, currently stretching to 56 pages, is at **tinyurl.com/358acerguide**.

What, no games?

You'll notice that I haven't mentioned games yet. Ironically, developers can design 3D games on the SpatialLabs 27 View Pro but they can't play them. That's because Acer wants gamers to buy the Predator SpatialLabs View 27, which includes Acer's TrueGame software: this allows you to launch supported games to run in 3D. The Predator is due out later this year at an estimated price of £2,199.

I most recently tried TrueGame on Acer's Predator Helios 3D laptop (*see issue 353, p56*), and although there are some misses it still blows my mind months after I first saw 3D games in action with my own eyes. You can view the list of currently supported games at **tinyurl.com/358truegame**.

There is some good gaming news. Thanks to SpatialLabs Go, you can play games that create a side by side view themselves. One example of that is Shadow of the Tomb Raider, and when I hooked up the Chillblast The Karve (*see p54*) it created a smooth, solid 3D landscape. It looks great, but whether playing games in 3D is worth the hoop jumping and GPU demands is another question entirely.

Flat switch

Naturally, this is a nice 4K monitor in its own right. With a gamut that stretches across 89% of the DCI-P3 colour space in its default mode and with an average Delta E of 0.56, it performed well in our technical tests. It hit 501cd/m² at its peak, far above Acer's stated maximum of 400cd/m², and a peak 160Hz refresh rate is not only great for games but also gives Windows a solidity when you move apps around.

Text looks sharp thanks to that 4K resolution, and if you switch the colour temperature to Normal then whites look Persil white, too. As with the Lenovo, the 3D lens overlay shows itself as minuscule grey dots on pure white backgrounds, but I soon stopped noticing this. And I never failed to appreciate the levels of detail in photos or 4K videos.

I'm less impressed by Acer's on-screen display, which is far less sophisticated than Lenovo's offering (which also works over USB to avoid fiddling with physical buttons). It relies on a joystick and three separate buttons tucked round the back, but it's easy to hit the wrong one. There are plenty of options, including presets for sRGB and DCI-P3 that lock you down to those colour spaces.

Connectivity options

If you're looking for a cable-free environment, again choose Lenovo. On the ThinkVision, a single USB-C cable is all you need to activate the 3D mode, and it can deliver 100W of power to your laptop, too. That's a great technical and design achievement because the 3D engine inside the monitor produces heat, and heat affects colour accuracy; the simpler choice is to use an external power brick to remove a heat source, and that's exactly what Acer chose to do. This means the View Pro's USB-C connector doesn't deliver any wattage to a connected laptop.



ABOVE Developers can design 3D games on the monitor but they can't play them

But many designers rely on a desktop workstation, and they can benefit from 3D effects over the HDMI or DisplayPort so long as they also connect the supplied USB-A to USB-C cable (the Lenovo screen works in exactly the same way, contrary to my original review, but with the benefit of an extra HDMI port). Doing so also gives you access to two USB-A ports on the rear, but these aren't easy to reach.

You can use the VESA mount – great for medical settings – but most people will stick to the supplied flexible stand. This provides a decent 33° of backwards tilt, 45° of swivel on either side and 150mm of height adjustment. There's no portrait mode as found on the ThinkVision, nor is it as good looking or well built as its rival, but there's one final extra in Acer's favour: it comes with a hood, which reduces ambient light.

Text looks sharp thanks to that 4K resolution, and if you switch the colour temperature to Normal then whites look Persil white, too

Do we have a winner?

Acer has got much right with the SpatialLabs 27 View Pro, even if there are few areas where I can declare it the outright winner compared to Lenovo's effort. One distinct plus is its speakers, while its integration with 3D creation software is significantly ahead of what Lenovo offers.

I don't like the fact that TrueGame isn't bundled. Are game creators meant to buy one SpatialLabs 3D screen to design on and another to play on? Isn't it simply mean not to bundle the software when you're charging people this much for a monitor? I would have also liked the reassurance of a three-year warranty rather than the typical one year, not to mention a powered USB-C port.

As with its rival, we don't yet have a confirmed release date or price. Acer estimates the former as late summer/Q3 and the latter as £2,599. This beats Lenovo's price by £101, which is welcome, but your final decision may well depend on exactly what 3D software you use. **TIM DANTON**

LEFT Acer has created plugins for a wide range of 3D software

SPECIFICATIONS

27in 3,840 x 2,160 AVHA panel up to 160Hz • 3D resolution, 2,160 x 1,920 • 8-bit panel (16.7 million colours) • 5ms response time (grey-to-grey) • DisplayPort 2.0 • HDMI 2.1 • USB-C 3.2 Gen 1 upstream (no power) • 2 x USB-A 3.2 Gen 1 • 2 x 2.5W speakers • -45° to 45° swivel • -7° to 33° tilt • 150mm height adjustment • 629 x 235 x 428-578mm (WDH) • 7.4kg • 1yr limited warranty

Philips 276B1JH

A feature-packed 1440p 27in USB-C docking monitor, but it's the same price as 4K rivals

SCORE ★★★★☆

PRICE £360 (£432 inc VAT) from uk.insight.com



ABOVE Colours are accurate for a monitor that's not aimed at creative professionals

Philips was one of the first monitor manufacturers to jump on the concept of USB docking monitors, and it's doubled down on the idea ever since. Here, it not only provides up to 90W of power over USB-C to a laptop, but even a DC connection to power an Asus or Intel NUC mini PC. With a mounting kit, this means you can attach a NUC to the back of your monitor and effectively turn it into an all-in-one PC. Add a wireless keyboard and mouse, and only the monitor's power cord will be visible.

Even if you choose not to go down this route, some cable routing could make this a stylish addition to a home worker's desk or in an office. The cable tidy (well, a square hole) is built into the bottom of the stand, through which you can thread a network cable for the RJ45 port and your choice of DisplayPort, HDMI or USB-C cables. The rear even includes a second DisplayPort for daisy-chaining another display, a 3.5mm jack, the DC output mentioned above and a trio of USB ports.

Two of these ports are USB-A, and while they're easy to access thanks to a stand that pivots, rotates and swivels with the grace of peak Roger Federer, you may prefer to keep them occupied with semi-permanent peripherals such as a mouse, keyboard and external storage. A further two USB-A ports sit on the left-hand side, making them even easier to use, and while I welcome the USB-C port at the rear – which can deliver 15W of power – it's a shame that Philips didn't find room for this connector on the side too.

Power is again on Philips' mind when you head into the OSD, with the PowerSensor option sitting at the top. Using infrared, this detects if someone is sitting in front of the monitor – and if they're not then it drops the brightness by up to 80%. There's also a light sensor that detects ambient lighting and adjusts the screen brightness accordingly.

Less useful is the LowBlue mode, which relies on you manually selecting the setting (from one to four) rather than using a sensor or timer to adjust it. But it's easy to activate: click the left-most shortcut button on the bottom bezel and you can cycle through this and other Philips SmartImage options, ranging from the mono EasyRead to Office to Photo to Game. Not that this monitor is tuned for gaming, as a 75Hz refresh rate reveals.

Anyone who loves tweaking colour settings will be left disappointed by this monitor's simplistic OSD, but you can at least choose the pre-calibrated sRGB mode. This locks brightness to its maximum, but I was impressed to see that it displayed 97% of the colour space with no leakage and excellent colour accuracy: its average Delta E was 0.43 and the maximum 1.31. The colour temperature was around 6200K rather than the target 6500K, but whites still look great on this IPS panel.

If you want a wider colour gamut, stick to the default profile, which is basically DCI-P3. The 276B1JH covered 90% of this colour space and 80% of Adobe RGB, which are strong figures for a monitor that isn't aimed at creative pros. And while Philips states a typical contrast ratio of 1,000:1 and brightness of 300cd/m², I measured significantly higher than that: 1,272:1 and 357cd/m² at its default settings.

LEFT The rear includes a second DisplayPort for daisy-chaining another display

"With a mounting kit, you can attach a NUC to the back of your monitor and effectively turn it into an all-in-one PC"

LEFT Two USB-A ports on the left of the screen make access easy

A Movie mode is available, but the pair of 3W speakers don't have the depth or subtlety to carry an atmospheric film. Nor would I choose to play music on them; I wrote "a bit screechy" in my notes, which tells you everything you need to know.

This monitor has one final notable feature, which is a webcam hidden into the top of the bezel. A simple press pops it up, and you'll be rewarded – probably too strong a word – with a 1080p, 30fps stream. It's no match for recent laptop webcams for quality, and its field of view is wider than ideal for solo calls, but it will get you through a meeting at a push. Perhaps its best feature is support for Windows Hello, and it worked perfectly when I tested this.

There's a huge amount to like about this docking monitor. I'd pick out its 90W power delivery over USB-C, its support for mini PCs, its daisy-chaining skills and its generous array of ports (including RJ45). Where it struggles is value, with the BenQ PD2706U and Iiyama ProLite XUB3293UHSN-B5 (*see issue 357, p86*) both offering high-quality 4K panels for a similar price. This means I can only recommend the Philips 276B1JH if its features match your needs perfectly. **TIM DANTON**

SPECIFICATIONS

27in 2,560 x 1,440 IPS panel • up to 75Hz refresh rate • 8-bit panel (16.7 million colours) • 4ms response time • DisplayPort 1.4 • HDMI 1.4 • USB-C (90W power delivery) • DisplayPort out • gigabit Ethernet • DC output • 4-port USB-A 3.2 Gen 1 hub • USB-C 3.2 Gen 1 • 1080p IR webcam • 2 x 3W speakers • 180° swivel • -5° to 30° tilt • 150mm height adjustment • 613 x 225 x 537-687mm (WDH) • 7.4kg • 2yr warranty



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Logitech Signature AI Edition M750

If you already own a Logitech mouse then don't buy it, but if not then this is a great way to quickly access ChatGPT

SCORE ★★★★★

PRICE £46 (£55 inc VAT) **from logitech.com**

This is a trojan mouse. I'm not referring to the Logi Bolt USB receiver and AA battery that live within, but for the excuse it gives us to review its accompanying software: Logi Options+, and in particular the AI Prompt Builder now baked into it, could prove a huge time-saver for anyone who currently owns a Logitech mouse or keyboard.

What marks out the Signature AI Edition M750 from the standard M750 (and all its brethren) is the green button that sits behind the scroll wheel. Pressing this button – once you've downloaded Logi Options+ and connected your OpenAI account – will give you instant access to ChatGPT services. You don't even need to pay for ChatGPT Plus, with the free option working perfectly well.

For example, if you select a paragraph in whatever app you happen to be working in then press the green button, it will offer you the option to rephrase the text, summarise it or draft a reply. All you need do is choose your preference and press Submit. So rather than head to a website and issue convoluted commands, you can do it by a press of a button without leaving the software you're in.

It's clever because at a literal stroke Logitech has bypassed the reason many people sign up to costly subscription services such as Microsoft Copilot and Google Gemini. One of those products' biggest attractions is their software integration, smoothing your workflow, but now you can press a button and tap into ChatGPT's power whether you're working in Word, Google Docs or Thunderbird.

For now, the integration is only with ChatGPT and works on Windows and macOS alone – so no Linux, no Chrome OS and no mobile OSes. Logitech is open to integrations with other AI services (such as Copilot, Gemini and Llama), but for now it appears that operating system support will be limited to Windows and Mac.

Logitech calls the instructions it sends to ChatGPT "recipes", and while it provides its own selection you can create your own easily. The key here is the prompt. Say you're a social media marketeer who wants to create headlines for posts. Set your prompt as "Turn this into a ten-word headline for Facebook" and then choose your tunable settings (for example, tone and length) and this recipe will appear in the pop-up when you press the green button.

ABOVE **The mouse's green button opens a world of AI options**





LEFT **You can also program the scroll wheel and side buttons**

"Logitech has bypassed the reason many people sign up to costly subscription services such as Microsoft Copilot and Google Gemini"

BELOW **Pressing the green button gives you instant access to ChatGPT recipes: simply press Submit**

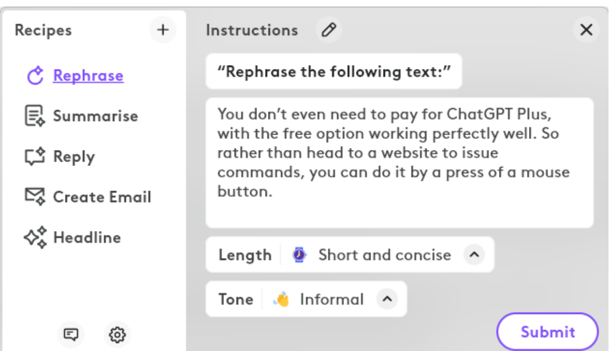
Naturally, you don't need to use the green button if you don't want to. Head into the Logi Options+ software and you can choose whichever of the buttons you like, and there are four to pick from – two on the left-hand side, pressing down on the scroll wheel and the green button. The latter is unique to the Signature AI Edition, and I found it incredibly handy; when I tried out the prompt builder on a regular Logitech mouse I had to retrain my muscle memory as I was so used to hitting that shortcut button for another reason.

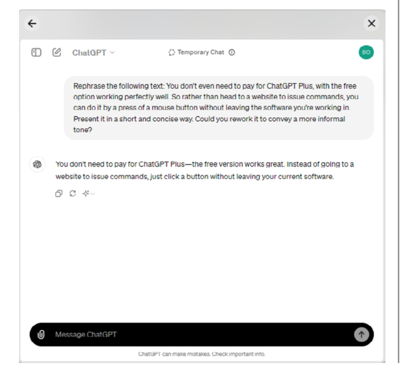
If you haven't used Options+ in a while, it's worth exploring the other features, too. In particular, Smart Actions are effectively mini macros that trigger a string of actions (such as mouse clicks, pasted preset text, system settings and application launches) that you perform frequently; perhaps a lunchtime or evening routine before you leave your desk.

As with the regular M750, you can pair the mouse with three different devices. Switching between paired devices (via the Bolt receiver or Bluetooth) is a simple matter of pressing a small button on the underside of the mouse. A white LED reveals if you're paired with device one, two or three.

Logitech reckons the AA battery will last for two years of regular office work (up to eight hours per day), while boosting its sustainability claims by using 61% recycled plastics. But, of course, the most sustainable thing you can do is keep using your existing equipment, and if that's a Logitech device with programmable buttons then there's no need to buy this mouse at all. You can also use a Logitech keyboard to trigger actions and the ChatGPT recipes.

I found it far smoother to hit a button on my mouse than on a keyboard, though, so if you're looking for a new pointing device then this is a great choice – and, by Logitech's standards, it's affordable, too. **TIM DANTON**





SPECIFICATIONS

4,000dpi wireless mouse • Bluetooth LE/RF • 1 x AA battery (supplied) • 61 x 108 x 39mm (WDH) • supports Windows 7 or later (Options+ supports Windows 10 or later), macOS 10 or later • 101g • 2yr warranty



Google Pixel 8a

A superb choice for those wanting AI features but don't want to spend a fortune on flagship phones

SCORE ★★★★☆

PRICE 128GB, £416 (£499 inc VAT) from store.google.com

If all you want is a cuter, more curvaceous version of the Pixel 8 (*see issue 351, p72*), the Pixel 8a delivers. Sure, it looks like every other Pixel phone since the Pixel 6, and that means the camera bar so many people hate, but I prefer its symmetry to the camera bump on most other phones.

The Pixel 8a also includes two flashy colour options to accompany the standard white and black. I loved the brighter than expected aloe green of my review sample – though some will prefer the more subdued mint green Pixel 8 – and there's bright "blue bay" on offer, too. The back is plastic, not glass, but the matte finish gives it a premium look.

There's only one disappointment, which is that only the black version comes in a 256GB variant (for £559). If you prefer racier colours, you're stuck with 128GB.

Starry display

Google's so-called Actua OLED displays are a key selling point for the Pixel 8 family, and the Pixel 8a keeps carrying the torch with a bright, colourful display that doesn't skimp on specs. It has a 120Hz refresh rate and the same claimed peak brightness (2,000cd/m^2) as the Pixel 8.

A smaller 6.1in diagonal ensures this is also a compact phone – even though the bezel is thicker than the current smartphone norm – and that makes it easy to hold. If you want bigger, the similarly priced OnePlus 12R (*see issue 355, p74*) has a 6.7in display that also goes brighter, but the only time I struggled to read the 8a's screen was with the sun directly overhead.

Indoors, the display looks exceptionally bright, and it hit 1,378cd/m^2 with the adaptive brightness setting on. It also covers 90% of the DCI-P3 colour space in Adaptive mode with an average Delta E of 0.24, so not only can you expect vivid colours but accurate ones, too.

Camera stardom

You can also take photos that will look amazing onscreen and on social media. Where they suffer is when you zoom in, as this reveals artefacts and fuzzy detail, so whether you'll be happy with the results boils down to what you do with them. For example, when I compared photos against the Pixel 8 Pro (*see issue 351, p70*), Google's best camera phone, the photos were remarkably similar – to the point that I couldn't tell the difference until I zoomed in (or in darker conditions, where the Pixel 8 Pro advantage was clear).

The Pixel 8a uses a 64MP sensor but it only outputs 16MP images. It combines four pixels into one in a process called "pixel binning", and there's no way to get full-resolution, 64MP shots from the Camera app. Even RAW image files only have a 16MP resolution.

Along with the same shooting modes as the Pixel 8 Pro – including long exposure for shots of moving traffic and running water – the 8a has the same AI editing tricks in the Google Photos app. That means Magic Eraser to remove unwanted people and Magic Editor to turn them into giants or move them to one side. Then there's Best Shot, which replaces faces in a group photo when somebody has their eyes closed, and it even has the amazing Audio Eraser for videos, to remove background noise and distractions.

What's especially great, if you're new to Pixel phones, is that you can edit photos and videos that you didn't shoot with your Pixel. Upload all of your old iPhone photos to Google Photos, then use Unblur to make them as sharp as new.

AI boost

More generally, the new AI tools built into Android keep getting better, and buying a Pixel remains the best way to access them. I now make a fresh AI wallpaper every few days and let Google's AI answer most of my impersonal phone calls; I can see what my caller says in a live transcript as the AI handles them. The Gemini AI features are increasingly good. It can now help compose email messages in the Gmail app, and I expect it will soon offer help in the mobile Docs and Sheets apps, too.

I also love the cleanness of Google's Android implementation, even if I miss the customisation options to organise your home screens and your app list. You can't even put apps into folders in Google's app menu.

On the other hand, Google does the best job with notifications. If you get a notification you don't want, you just hold you finger on the message and you get a robust settings tool that lets you turn off all notices from an app, or just certain categories of interruptions. You get to pick what each app notifies you about, and you don't have to dig to find the options. They just appear with a press.

There's one other key area where Google wins over rivals, and that's support. Even though this is its mid-range phone, the 8a comes with the same seven years of Android updates as its more expensive siblings. Sure, the one-year warranty isn't great, but with an IP67 rating this phone is superbly protected against water and dust. You might want to spend £19 on the Case-Mate Ultra screen protector at time of purchase, though.

Full speed behind

The Pixel 8a comes with the same Tensor G3 chip as the Pixel 8, but don't expect a phone that will top the benchmark charts. Any Android rival with a Snapdragon 8 Gen 2 or faster, and any recent iPhone, will

ABOVE The Pixel 8a has the same Actua OLED screen as its more expensive sibling



"The new AI tools built into Android keep getting better, and buying a Pixel remains the best way to access them"

LEFT Take your pick of aloe green and bright blue bay finishes as well as white and black

outperform the Pixel 8a. What does that mean in the real world? Not much.

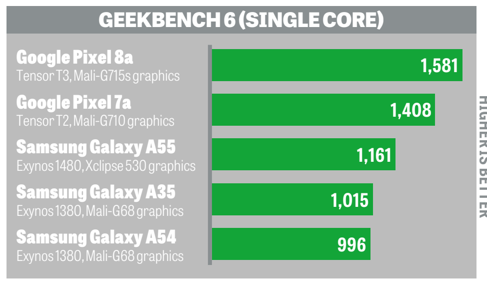
Unless you're playing the most demanding games or using advanced photo- or video-editing tools, the Pixel 8a will keep up. It ran all of my games, including *Call of Duty* and *Marvel Snap*, with no trouble. It just won't play the most demanding games as smoothly as, say, the Galaxy S24 (*see issue 355, p72*).

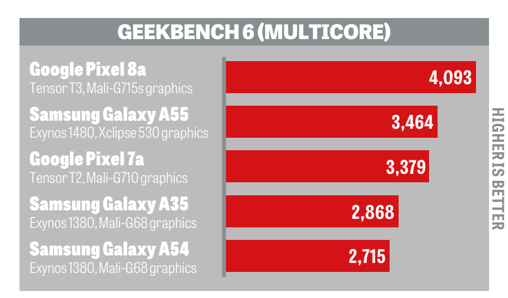
There was some delay with many of the AI features, but that's because the Pixel 8a needs to talk to Google before it can give you an answer. Even AI wallpapers rely on Google's cloud for help, and there's a back and forth delay.

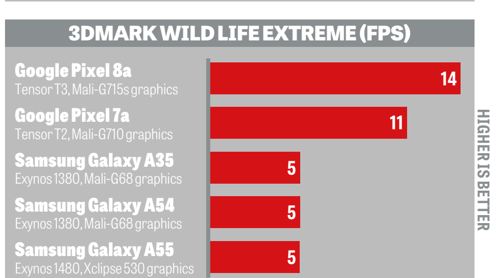
I also had some trouble using Bluetooth on the Pixel 8a. The phone kept finding and refinding my Pixel Buds Pro, and one week I had to reconnect them three times. It was a similar story with my car stereo, and twice it lost my Ray-Ban Meta smart glasses.

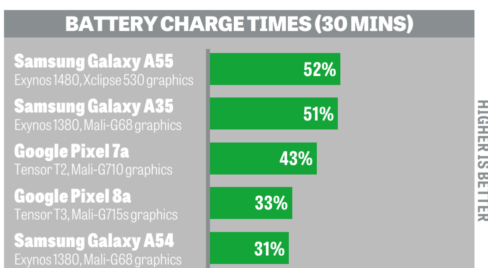
Battery blues

However, if there's one thing that would stop me buying the Pixel 8a, it's battery life. That's not a surprise considering the Pixel 7a and Pixel 6a suffered the same shortcoming. In my real-world testing, the Pixel 8a never lasted a full day of use. I used the phone at home, for work and when travelling, and it usually needed a top-up after dinner. This could be a 5G issue, however, as those in 4G areas don't seem to suffer from the same issue.









Using our more scientific rundown test, the Pixel 8a lasted for 11hrs 21mins. To compare, the OnePlus 12R – our pick for best battery life – topped 19 hours in the same test, and it charges much faster: the Pixel got to 33% after half an hour, the 12R to 96%. At least the Pixel 8a supports wireless charging.

In Google's defence, the OnePlus 12R costs £649, only comes in one colour – "Iron Gray" –and in one configuration with 256GB of storage. It's also considerably larger.

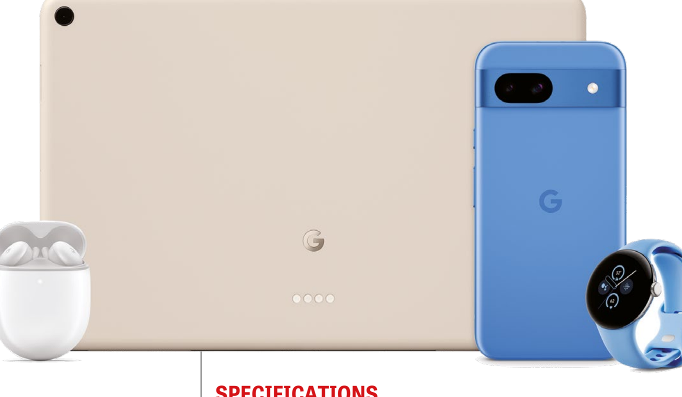
The Pixel 8a isn't the perfect sub-£500 phone. It falls behind its rivals for battery life, with the stylish Samsung Galaxy A35 and A55 (*see overleaf*) both cheaper and packing larger batteries. And the OnePlus 12R, with its Snapdragon 8 Gen 2 chip, is much faster.

However, I don't want to be too critical of the 8a's performance. It's more than fast enough in everyday tasks, and I have little doubt that it will still be going strong in seven years' time when Google drops its final Android update for the phone.

This is also the most affordable way to gain access to the AI features otherwise restricted to flagship phones – and if you take advantage of Google's generous trade-in deal then it's even better value. If you don't want to overspend on your phone but you do want the latest features, it's a great long-term choice. **PHILIP BERNE**

LEFT The opinion-splitting camera bar is still present

"It's more than fast enough in everyday tasks, and I have little doubt that it will still be going strong in seven years' time"



BELOW The Google ecosystem covers all your mobile computing needs



LEFT The Pixel 8a joins the larger and dearer Pixel 8 and Pixel 8 Pro in Google's lineup

SPECIFICATIONS

9-core Google Tensor G3 processor • 8GB RAM • Immortalis-G715s MC10 graphics • 6.1in 120Hz AMOLED screen, 1,080 x 2,400 resolution • 5G • 128GB/256GB storage • IP67 rating • dual 64MP/13MP rear cameras • 13MP front camera • Wi-Fi 6E • Bluetooth 5.3 • NFC • 4,492mAh battery • USB-C 3.2 Gen 1 connector • Android 14 • 73 x 8.9 x 152mm (WDH) • 188g • 1yr warranty

Samsung Galaxy A35 5G

A mid-range mobile with a handful of premium features, including a great-looking 6.6in OLED display

SCORE ★★★★☆

PRICE 128GB, £241 (£289 inc VAT) **from johnlewis.com**

Their launches lacked the razzmatazz of the S24 series, but Samsung has just released two affordable phones: the A35 on review here and the A55 opposite. The idea is to strip back in some areas, most notably speed and camera setups, while still delivering a stylish design and a stunning screen.

Despite its low price, the A35 has a Gorilla Glass front and back, with a choice of four colours: ice blue, navy, lilac and lemon. It's the latter and rather striking colour you see here. All four colours are relatively restrained given the vibrancy of previous Galaxy A series phones, but that isn't necessarily a bad thing.

At 209g and 8.2mm thick it's on the hefty side, but in return you benefit from a 6.6in OLED screen. It will make you forget you're using a budget phone, with a 120Hz refresh rate and sharp 1,080 x 2,340 resolution. The screen is bright, with a maximum brightness of 1,000cd/m², and colours pop. I thoroughly enjoyed watching Netflix and playing games on the Galaxy A35.

While the Exynos 1380 processor and Mali-G68 graphics are both distinctly mid-range, it actually performed admirably in my real-world testing. It blitzed through many games of *Call of Duty Mobile* and *PUBG Mobile* without significant lag. Yes, it becomes warm after a while, but mobile gamers on a budget won't find anything else to dislike here.

I found that its performance in Geekbench dropped when it was running warm; when cold, it scored in the low 2,900s but that fell to the mid 2,700s after a few runs. Still, the phone felt snappy and fast to navigate, which isn't guaranteed at this price. There's 6GB of RAM if you choose the model with 128GB of storage, or 8GB with the £339 256GB model.

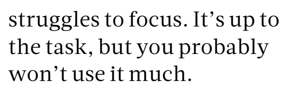
There's no 3.5mm jack here, while the stereo speakers are serviceable for games but wouldn't be my choice for listening to music. This also draws attention once more to the size of this device, with the volume rocker buttons on the top right edge – unless your hands are large you may find yourself stretching to reach them. Samsung uses an under-display fingerprint sensor, but it failed to find my finger more often than it succeeded. With no facial recognition, I ended up typing in my password far more often than on most other mobiles.

PC PRO RECOMMENDED

The other inevitable compromise comes via the cameras, but the A35 still features a trio at the rear: a 50MP, f/1.8 main unit, an 8MP/f.2.2 for ultrawide shots and a 5MP, f/2.4 macro offering.

In well-lit conditions, the main camera takes bright and colourful pictures, with flowers and food looking bold. That's partly due to Samsung's scene optimisation AI processing, which is a staple of Galaxy phones. It ratchets up the contrast and saturation, and also drizzles in extra sharpening and HDR. It's great for snappy social media posts and selfies, less so for seasoned photographers hoping to catch a "true" image.

I wasn't impressed by its wider shots, where quality and detail both suffered, and the A35 struggled in low light. Don't think that switching to the ultrawide camera will help, with images looking dull compared to rivals. The macro camera is better, being called into action for shots so close that the main camera struggles to focus. It's up to the task, but you probably won't use it much.



The 13MP f/2.2 selfie camera is much better – so long as you don't mind Samsung's optimisations – while video recording is respectable at 4K/30fps or 1080p at 60fps.

The A35 ships with Android 14 and Samsung's One UI 6.1 slathered on top, with four years of updates (and an extra year of security updates). So it's not up to the seven years of the Pixel range, but is still solid. The One UI comes with more bloatware than I'd expect from Samsung, plus the usual distinctive pebble-shaped icons and colourful menus. Purists may prefer Google's interface, but there are plenty of customisation options to help you tweak it to your liking. I also like the "Modes and Routines" feature, which lets you jump from, say, sleep, driving or workout modes at the tap of a button.

ABOVE The Galaxy A35 has a stunning screen for the price

You can choose a low-power mode to eke out the battery, but with a 5,000mAh unit inside I found the phone comfortably lasted for a full day's use. That's despite the big, bright screen and 5G connectivity. There's no wireless charging support, while a 25W maximum charge rate is relatively slow, but it still got to 51% after half an hour.

"The 6.6in OLED screen will make you forget you're using a budget phone, with a 120Hz refresh rate and 1,080 x 2,340 resolution"

It's easy to concentrate on the things you're not getting with this phone, but look at that price. It simply doesn't feel like a sub-£300 phone, and even comes with an IP67 rating. In many ways, it feels like a budget Galaxy S24 (*see issue 355, p72*), with the display, software and even performance reaching beyond the A35's low-to-mid-range price tier. It's a great-value phone, offering strong competition to both the A55 and the Pixel 8a (*see p74*). **TOM BEDFORD**

LEFT The rear cameras can produce decent shots in good light

BELOW The A35 is well suited to mobile gamers on a budget



SPECIFICATIONS

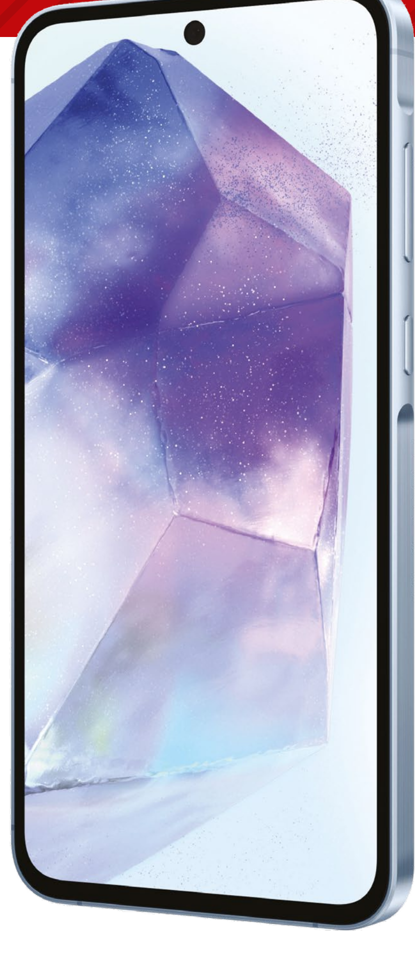
8-core Samsung Exynos 1380 processor • 6GB/8GB RAM • Mali-G68 MP5 graphics • 6.6in 120Hz AMOLED screen, 1,080 x 2,340 resolution • 5G • 128GB/256GB storage • microSD card slot • IP67 rating • triple 50MP/8MP/5MP rear cameras • 13MP front camera • Wi-Fi 6 • Bluetooth 5.3 • NFC • 5,000mAh battery • USB-C 2 connector • Android 14 with One UI 6.1 • 78 x 8.2 x 162mm (WDH) • 209g • 1yr warranty

Samsung Galaxy A55 5G

Offers far more than you might bargain for at this price, with the 6.6in OLED screen particularly strong

SCORE ★★★★☆

PRICE 128GB, £303 (£364 inc VAT) from johnlewis.com



The A55 almost acts as a bridge phone from Samsung's true budget range – including the A35 opposite – to the premium Galaxy S24 series. At first glance, you might even think the A55 is part of that more expensive family, with the trio of cameras on the glass rear almost identical to those found on the Galaxy S24 and S24+ (*see issue 355, p72*).

One unique element to Samsung's latest Galaxy A models is a raised portion of the side rail, which contains the volume and power buttons. It's a subtle effect you can see in the main photo, and I found my thumb resting naturally on the slope up towards the power button. There's even a pleasant brushed texture to the bump, increasing the feel of luxury, although the thicker bezels and lighter weight reveal this isn't a premium Samsung device.

It's also quite large, but that's reflected in the size of the 6.6in OLED panel. This sits in between the 6.2in and 6.7in displays found on the S24 and S24+, and while it can't match those phones for pixel density, I don't think anyone will complain about the 1,080 x 2,340 pixels here: it's still sharp. What's more, you benefit from 120Hz refresh rates and the same peak brightness (1,000cd/m²) and punchy colours we mentioned in our review of the A35.

Samsung clads both phones with Gorilla Glass Victus Plus on the front and back, which may be dated but remains effective toughened glass. The water/dust resistance rating of IP67 is similarly good, albeit not flagship quality. And you get the same choice of colours as the A35; I tested the classy ice blue version, which is spicier than the more conservative Galaxy S palettes.

The camera setup is identical to that of the Galaxy A54, with a 50MP main camera, 12MP ultrawide and a 5MP macro at the rear, and a 32MP front camera. As such, it's no great surprise that its results are almost identical. You get the same rich, saturated colours, with good detail capture so long as the lighting levels are respectable. It's when things become more challenging – such as low lighting or the sun casting a strong backlight on your subject – that this phone shows its budget roots. And with no zoom, the A55 is far better suited to close-up shots than it is capturing faraway detail. Even though it lacks an optical zoom, those who prioritise photography will be better off with the Pixel 8a (*see p74*) in their pocket.

The Pixel 8a and A55 scored similarly in our main Geekbench tests, and both phones should offer a fluid, enjoyable experience for years to come. I was hoping for more from the new Samsung Exynos 1480 processor, but this was never destined to be a super-powerful chip. This was amply reflected in its 3DMark Wild Life Extreme scores, where it averaged 5.4fps compared to 11fps for the Pixel 8a.

When playing games, though, the A55's frame rates held steady. So long as you're aren't overly fussy – I noticed poor anti-aliasing for the cars and backgrounds in *Grid Autosport* – it should keep you entertained.

There's one more piece of good news for gamers, which is that Samsung includes a microSD card slot. So if you can't stretch to £414 for the 256GB option, there's an easy way to add up to 1TB of storage.

This phone also offers plenty of stamina thanks to a 5,000mAh battery. In my real-world tests – it drained by 22% after watching three hours of YouTube, which compares well to similarly priced rivals – it lasted for reassuringly long periods. A full day's use won't be a problem. And when it was time to charge, it went from zero to 52% in half an hour. That was with my own 25W charger, as Samsung doesn't include one in the box. Nor do you get wireless charging.

ABOVE The raised side rail containing the volume and power buttons has a nice feel

LEFT An IP67 rating means you can use the A55 in wet conditions

"Knox Vault is a secure part of your phone's chipset that houses important data such as passwords, keeping it safe from hackers"

BELOW Snaps from the rear cameras have rich, saturated colours and good detail

Those hoping for the latest AI tricks will be disappointed. It's Android 14 with One UI 6.1 on top, but features such as Circle to Search are missing. If you want those kind of extras, once again the Pixel 8a is a better bet. Google also wins for its seven years of software and security updates, but I don't want to be too harsh: you still get four years of full udpates and five years of security updates with the A55, which is a good deal for a phone at this price.

Knox Vault is a new feature for the latest Galaxy A phones, passed down from Samsung's flagships. This is a secure part of your phone's chipset that houses important data such as passwords and biometric data, keeping it safe from hackers, and even "self-destructing" your data if it detects physical interference.

This is one area where it wins over the Pixel 8a, with a couple of other notable plus points elsewhere, too. Top of my list is the larger OLED panel, but if you love taking macro shots then note the A55's third rear camera – something the Pixel 8a lacks. The Galaxy A55 also offers better battery life than the Pixel 8a.

Ultimately, however, the main factor in the Galaxy A55's favour is its price. Although this phone's official RRP is £439 for the 128GB version and £499 for 256GB, it didn't take long for those prices to be discounted both on Samsung's website and partners such as John Lewis. That means it offers better value than Google's new phone, and if that's your priority then both the A55 and A35 are well worth considering. **RICHARD PRIDAY**



SPECIFICATIONS

8-core Samsung Exynos 1480 processor • 8GB RAM • Xclipse 530 graphics • 6.6in 120Hz AMOLED screen, 1,080 x 2,340 resolution • 5G • 128GB/256GB storage • microSD card slot • IP67 rating • triple 50MP/12MP/5MP rear cameras • 32MP front camera • Wi-Fi 6 • Bluetooth 5.3 • NFC • 5,000mAh battery • USB-C 2 connector • Android 14 with One UI 6.1 • 77 x 8.2 x 161mm (WDH) • 213g • 1yr warranty



NAS DRIVES

For advanced users and small businesses, network-attached storage is arguably the most versatile and cost-effective way to handle backups, media streaming and collaboration



Network-attached storage (NAS) may be one of the dullest sounding technologies, but in practice it's one of the most brilliant. Sure, buying a NAS drive can be an important part of any backup strategy – see Jon Honeyball's advice this month from p110 – but thanks to the range of apps found on modern NAS devices they now serve a range of uses.

For a start, they can save you a lot of money in the long term by replacing subscription services. They can act as your own gigantic Dropbox, allowing you to share files with friends, family and colleagues in a way that you control. That's particularly useful for photos and videos that you've captured over the years.

Then there's the other type of video: films. Load up Plex, for instance, and you can stream your collection whenever and wherever you like, without giving Netflix £17.99 per month. And if you still want to subscribe to your favourite services, fear not, as Plex ties in with Netflix, Prime Video, Disney+ and more. You can also use Plex to stream music, but Asustor, QNAP and Synology provide their homegrown systems, too.

Other usage may sound more niche, but with 24/7 access and low power consumption there's a good reason why many people choose a NAS for their video surveillance system, to store virtual machines and to host websites.

Whether you're new to NAS drives or looking for something more powerful, this comprehensive review of the most popular offerings should hold the answer.

CONTRIBUTOR: Simon Handby

CONTENTS



	Asustor Flashstor 6	Asustor Nimbustor 4 Gen2	OWC Mercury Elite Pro Dual	QNAP TS-233	QNAP TS-253E	QNAP TS-264
		LABS WINNER			RECOMMENDED	RECOMMENDED
Overall rating	★★★★☆	★★★★★	★★★☆☆	★★★☆☆	★★★★★	★★★★☆
Information						
Model number	FS6706T	AS5404T	4TB with 3-port USB Hub	TS-233	TS-253E-8G	TS-264-8G
Price (inc VAT)[1]	£374 (£449)	£441 (£529)	£262 (£315)	£158 (£190)	£423 (£507)	£333 (£400)
Supplier	amazon.co.uk	amazon.co.uk	megamac.com	amazon.co.uk	amazon.co.uk	morecoco.co.uk
Manufacturer's website	asustor.com	asustor.com	owc.com	QNAP.com	QNAP.com	QNAP.com
Warranty	3yr	3yr	3yr (with drives)	2yr	3yr	3yr
Technical features						
Type	Barebones NAS	Barebones NAS	External hard disk	Barebones NAS	Barebones NAS	Barebones NAS
Internal storage	6 x NVMe (PCI-E Gen3)	4 x SATA, 4 x NVMe (PCI-E Gen3)	2 x SATA	2 x SATA	2 x SATA, 2 x NVMe (PCI-E Gen3)	2 x SATA, 2 x NVMe (PCI-E Gen3)
RAID support	RAID0, RAID1, RAID5, RAID6, RAID10, JBOD	RAID0, RAID1, RAID5, RAID6, RAID10, JBOD	RAID0, RAID1, JBOD, SPAN	RAID0, RAID1, JBOD	RAID0, RAID1, JBOD	RAID0, RAID1, JBOD
CPU	Intel Celeron N5105	Intel Celeron N5105	N/A	ARM 4-core Cortex A55 2.0GHz	Intel Celeron J6412	Intel Celeron N5095
RAM (maximum)	4GB (16GB)	4GB (16GB)	N/A	2GB (2GB)	8GB (8GB)	8GB (8GB)
Claimed max read speed	590MB/sec	599MB/sec	1,250MB/sec	114MB/sec	590MB/sec	589MB/sec
Claimed max write speed	590MB/sec	599MB/sec	1,250MB/sec	103MB/sec	589MB/sec	589MB/sec
Hardware encryption	✗	✗	✗	Accelerated	Accelerated	Accelerated
Physical design						
Ethernet port(s)	2 x 2.5GbE	2 x 2.5GbE	N/A	1 x 1GbE	2 x 2.5GbE	2 x 2.5GbE
USB ports	2 x USB-A 3.2 Gen 2, 2 x USB-A 2	3 x USB-A 3.2 Gen 2	1 x USB-C 3.2 Gen 2 host port, 1 x USB-C 3.2 Gen 2, 2 x USB-A 3.2 Gen 2	1 x USB-A 3.2 Gen 1, 2 x USB-A 2	2 x USB-A 3.2 Gen 2, 2 x USB-A 2	2 x USB-A 3.2 Gen 2, 2 x USB-A 2
Expansion options	AS6004U HDD expansion via USB	AS6004U HDD expansion via USB	Additional external drives via USB	✗	Multiple tower and rackmount expansion enclosures	2 x PCI-E Gen 3 supporting 10GbE or 2 x QM2 NVMe expansion cards, multiple tower and rackmount expansion enclosures
Dimensions (WDH)	309 x 193 x 49mm	174 x 230 x 170mm	85 x 239 x 147mm	92 x 158 x 186mm	105 x 165 x 227mm	105 x 165 x 227mm
Extras						
Bundled software	Download Center, Looks Good, Photo Gallery 3, Surveillance Center	Download Center, Looks Good, Photo Gallery 3, Surveillance Center	✗	Qsync Central, Download Station, Photo Station, Video Station	Qsync Central, Download Station, Photo Station, Video Station	Qsync Central, Download Station, Photo Station, Video Station
Supplied accessories	2 x CAT 5e cables	2 x CAT 5e cables	1 x USB-C cable, 1 x USB-C to USB-A cable	2 x CAT 5e cables	2 x CAT 5e cables	2 x CAT 5e cables

[1]Prices were at time of going to press and are for UK mainland only

				RECOMMENDED		
QNAP TS-464	**Synology DiskStation DS223**	**Synology DiskStation DS224+**	**Synology DiskStation DS423+**	**Synology DiskStation DS923+**	**TerraMaster F2-212**	**TerraMaster F4-424**
★★★★☆	★★★☆☆	★★★☆☆	★★★★☆	★★★★☆	★★☆☆☆	★★★☆☆
TS-464-4G	DS223j	DS224+	DS423+	DS923+	F2-212	F4-424
£484 (£581)	£204 (£244)	£261 (£313)	£396 (£475)	£450 (£540)	£142 (£170)	£400 (£480)
ebuyer.com	ballicom.co.uk	ballicom.co.uk	ballicom.co.uk	ballicom.co.uk	amazon.co.uk	amazon.co.uk
QNAP.com	synology.com	synology.com	synology.com	synology.com	terra-master.com	terra-master.com
3yr	2yr	2yr	3yr	3yr	2yr	2yr
Barebones NAS	Barebones NAS	Barebones NAS	Barebones NAS	Barebones NAS	Barebones NAS	Barebones NAS
4 x SATA, 2 x NVMe (PCI-E Gen3)	2 x SATA	2 x SATA	4 x SATA, 2 x NVMe (PCI-E Gen3)	4 x SATA, 2 x NVMe (PCI-E Gen3)	2 x SATA	4 x SATA, 2 x NVMe (PCI-E Gen3)
RAID0, RAID1, RAID5, RAID6, RAID10, JBOD	RAID0, RAID1, JBOD	RAID0, RAID1, JBOD	RAID0, RAID1, RAID5, RAID6, RAID10, JBOD	RAID0, RAID1, RAID5, RAID6, RAID10, JBOD	RAID0, RAID1, JBOD	RAID0, RAID1, RAID5, RAID6, RAID10, JBOD
Intel Celeron N5095	Realtek RTD1619B	Intel Celeron J4125	Intel Celeron J4125	AMD Ryzen 1600	Realtek 1619B (4-core 1.7GHz)	Intel N95
8GB (8GB)	2GB (2GB)	2GB (6GB)	2GB (6GB)	4GB (32GB)	1GB (1GB)	8GB (32GB)
589MB/sec	113MB/sec	226MB/sec	226MB/sec	592MB/sec	112MB/sec	283MB/sec
589MB/sec	113MB/sec	224MB/sec	226MB/sec	562MB/sec	110MB/sec	283MB/sec
Accelerated	Yes	Yes	Yes	Yes	Yes	Yes
2 x 2.5GbE	1 x 1GbE	2 x 1GbE	2 x 1GbE	2 x 1GbE	1GbE	2 x 2.5GbE
2 x USB-A 3.2 Gen 2, 2 x USB-A 2	3 x USB-A 3.2 Gen 1	2 x USB-A 3.2 Gen 1	2 x USB-A 3.2 Gen 1	2 x USB-A 3.2 Gen 1	1 x USB-A 3.2 Gen 1, 1 x USB-A 2	1 x USB-C 3.2 Gen 2, 1 x USB-A 3.2 Gen 2
2 x PCI-E Gen 3 supporting 10GbE or 2 x QM2 NVMe expansion cards, multiple tower and rackmount expansion enclosures	✗	✗	✗	PCI-E Gen 3 x2 network upgrade slot, eSATA port	✗	Various desktop attached storage enclosures via USB
170 x 165 x 227mm	108 x 165 x 232mm	108 x 165 x 232mm	199 x 166 x 223mm	199 x 223 x 166mm	119 x 154 x 222mm	179 x 154 x 222mm
Qsync Central, Download Station, Photo Station, Video Station	Synology Drive, Synology Office, Synology Photo, Synology Surveillance Station	Synology Drive, Synology Office, Synology Photo, Synology Surveillance Station	Synology Drive, Synology Office, Synology Photo, Synology Surveillance Station	Synology Drive, Synology Office, Synology Photo, Synology Surveillance Station	Terra Photos, TerraSync, Surveillance Manager	Terra Photos, TerraSync, Surveillance Manager
2 x CAT 5e cables	1 x CAT 5e cable	2 x CAT 5e cables	2 x CAT 5e cables	2 x CAT 5e cables	1 x CAT 5e cable	1 x CAT 6 cable

How to choose the right NAS for your needs

Every NAS will do the basic job of storing and serving files on your network, but when it comes to choosing the perfect appliance for you there are important factors to consider

How many bays do I need?

We strongly advise you to steer clear of single-disk NAS systems. If a single disk holds the only copy of your irreplaceable data and it fails, you're in trouble. It's much safer to go for a two-bay system and configure it with two hard disks in a RAID1 array.

In this configuration, your data is mirrored between both drives. If one fails, you'll still have the copy on the other one. Just be sure to replace the broken disk promptly so the NAS can rebuild your array and restore your protection. Don't be tempted by other two-disk configurations such as JBOD or RAID0: these offer more capacity and can be faster, but they lack the fault tolerance of RAID1.

A four-bay NAS drive is more versatile. With three or four disks you can set up a RAID5 array, which offers a better balance of capacity and data security. For example, if you install four 1TB drives, you can store up to 3TB of data, and if any one drive fails you can simply drop in a replacement and carry on working. For mission-critical data, consider RAID6. This can survive two drives failing simultaneously, but it offers a lower overall capacity.

It's increasingly common to find NVMe slots on mid-range NAS units. These support SSDs, which offer faster storage, or caching for the main disks, or both. You'll need two SSDs to create a read/write cache, as it requires data redundancy.

What connections should I look out for?

A home NAS only needs one network port, but if you're buying for business two is better – you can configure them to provide more bandwidth or failover support. Gigabit Ethernet is fine for general home use, but enthusiasts and business buyers should hold out for 2.5GbE – as the name suggests, it's up to two-and-a-half times quicker, and that can make a huge difference.



RIGHT Front-panel USB ports are useful for one-touch copying



ABOVE Drives such as Asustor's Nimbustor 4 and QNAP's TS-264 include powerful CPUs

Most NAS appliances offer USB-A or USB-C ports that can be used to connect an external hard disk; a very simple way to add extra storage. Front-panel USB connectors are often used for one-touch copying. Simply plug in a USB hard disk, press the copy button and the entire contents of the external drive will be copied into a default location on the NAS. If your data is currently scattered across a selection of external drives, it's an easy way to consolidate all your files into one place. Look out for USB 3.2 Gen 2 rather than Gen 1, as this doubles the bandwidth from 5Gbits/sec to 10Gbits/sec.

> **With three or four disks you can set up a RAID5 array, which offers a better balance of capacity and data security**

Some appliances offer eSATA, which is used to hook up a secondary drive enclosure to your NAS. You may also see HDMI and audio sockets. These let you use built-in apps to turn your NAS box into a video player, surveillance station or audio jukebox.

How do I get the best performance?

To get the best from a NAS, make sure it's plugged into a switch or router that supports its maximum network interface speed. Ideally, other network devices should be wired into the same router, and their interfaces upgraded if necessary to the same speed. That's not always practical, but so long as the switch doesn't act as a bottleneck you'll still see strong performance.

File-transfer speeds can reach 113MB/sec over a 1GbE connection and 283MB/sec over 2.5GbE, but if you're copying a folder containing lots of small files then the file system overhead will mean that things go a lot more slowly, as our graphs on p94 show.

Running certain apps can slow a NAS down, as can multiple users competing for its resources. In this case you might get a bigger throughput overall if your NAS has lots of memory, an SSD disk cache or two Ethernet ports, but this won't increase the maximum speeds available to individuals.

Do I need special NAS hard disks?

NAS devices usually run all the time, and can have multiple drives in close proximity, generating more heat than you'd get in a PC. Hard disk manufacturers offer NAS-specific drives designed to last in these conditions. If you're buying new disks to use in your NAS, it makes sense to buy these, preferably using the NAS manufacturer's website to check that they're compatible.



However, there's nothing to stop you using regular hard disks in a NAS. In our experience, drives always seem to work even if they're not on the compatibility list – provided they're SATA. If you have a collection of older disks, it may make sense to use these up first, and replace them with NAS-specific drives if they fail.

The same advice is generally true if you're buying NVMe drives, but here you should pay extra attention to the compatibility list. You can't, for example, use non-approved NVMe drives as a storage pool in Synology enclosures. In heavily used systems, you may need to add heatsinks to individual NVMe drives to help cool them.

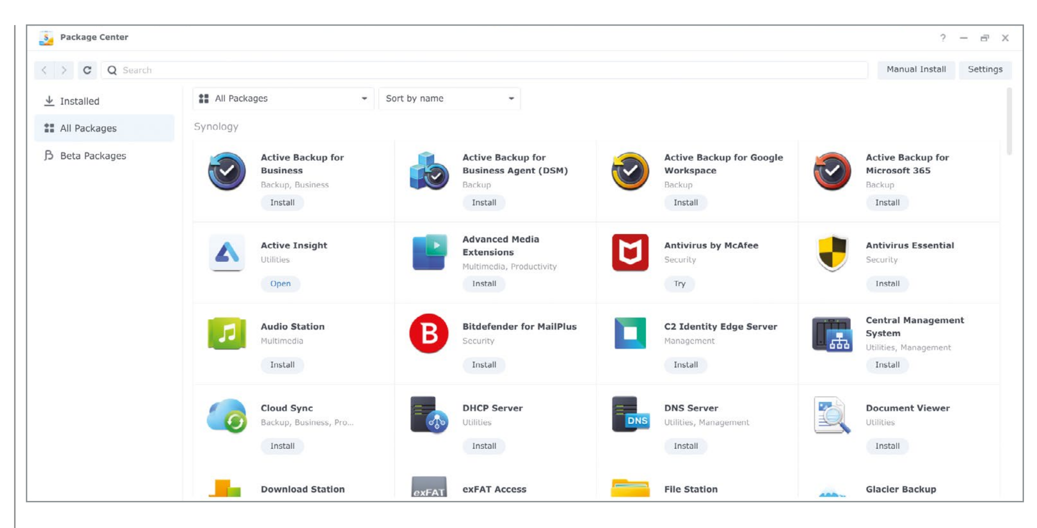
What about apps?

Most modern NAS systems provide all the basic services you need right out of the box, including protocols for talking to Windows, macOS and Linux clients. They'll also integrate with Apple's Time Machine backup service – you can turn this on with a click – so you can keep your Mac clients effortlessly backed up. For corporate deployments, many NAS units also support iSCSI and Active Directory, while most offer some form of remote access – both for management, and for features and services.

Even so, have a browse through the apps available as these can extend the capabilities of your NAS appliance in all sorts of ways. All the units here come with an app store containing tens of additional apps. These invariably include a selection of media server apps, which allow your NAS to stream audio and video to smart devices in your home. Most apps are free, although occasionally you'll need a licence to add functionality.

In addition, you'll find business and development tools, surveillance tools that work with IP cameras, and even content management systems such as WordPress. Some even offer rivals to Google Docs. Furthermore, it's now common to find support for virtualisation through Docker.

If an app you want to use isn't listed in the store, it may be possible to install it manually, but for obvious reasons we don't recommend this unless you're confident in your technical abilities.



ABOVE Apps can extend the capabilities of your NAS device in all sorts of ways

One caveat: you'll need a powerful NAS to run a whole load of apps and services. It's a good idea to pick one with an Intel or AMD processor. And make sure there's plenty of RAM, or that you can add more. If you're not sure about how much headroom you have, there's normally an activity monitor available within the appliance's web interface, exposing what's using its CPU and RAM, so you can spot any services that might be overtaxing your hardware.

Remember that a modern NAS is effectively a fully featured computer, and as such it may be susceptible to online attacks

Also bear in mind that your internet connection could limit your NAS's ability to serve web pages or provide remote access to family members or employees. Most routers and some NAS enclosures let you set rules to manage bandwidth, but it's worth taking into consideration.

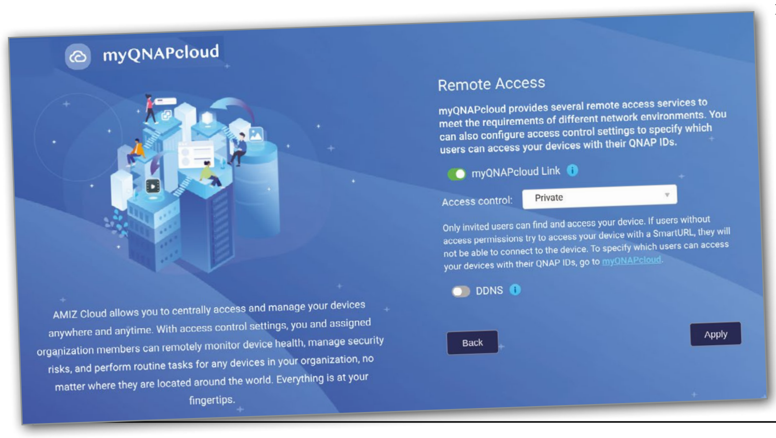
Can I access my files remotely?

It used to be hard to set up secure remote access to your NAS, but these days every manufacturer makes it simple to find and connect to your server. This could be a tremendously useful alternative to cloud services such as Dropbox and Google Drive, with no monthly fee and a lot more storage. It could also reduce your environmental impact, particularly if your NAS runs on a green energy source like solar power.

Many providers offer some degree of integration with third-party cloud services, so – for example – you can easily ensure that the files in a certain folder on your NAS appliance are synchronised with your Dropbox or Google Drive account. This can be handy if your home or office printer supports the same service, as it saves you having to mess around manually moving files back and forth.



BELOW A NAS device can provide a superb cloud storage solution



What do I need to know about security?

The first thing to remember is that even with data redundancy, RAID isn't infallible. Your NAS could be fried in a fire, or even be stolen in a break-in. It's a good idea to consider an offsite backup: many NAS systems come with integrated support for systems such as Amazon S3 or ElephantDrive, which will store very large amounts of data for a (comparatively) modest monthly fee. Alternatively, if you have access to a NAS appliance in a second location, most units will let you replicate your data over the internet, using either the industry-standard rsync utility or a bespoke service.

Remember that a modern NAS is effectively a fully featured computer, and as such it may be susceptible to online attacks. You should make a point of installing system updates as soon as possible – most NAS appliances can be set to do this automatically in the middle of the night. Make sure your apps and services are up to date, too: platforms such as WordPress are frequently exploited by hackers.

Finally, don't forget that your NAS's on-board security can't protect you from malware that's running on a PC and abusing your credentials to tamper with your data. Some ransomware specifically targets NAS appliances. The best defence is to make sure your clients are properly patched and virus-free, but we also recommend you configure snapshot protection, widely available if you format with the Btrfs file system.

Jon Honeyball covers much of this in his Real World Computing column from p110 this month.

Asustor Nimbustor 4 Gen2 AS5404T

A particularly strong choice as a media server, the updated Nimbustor 4 is both flexible and quick

SCORE ★★★★★

PRICE £441 (£529 inc VAT)
from amazon.co.uk

Asustor's Nimbustor 4 AS5404T is a four-drive NAS enclosure aimed at demanding home users or small offices. It's a performance-focused NAS thanks to the fairly muscular Intel Celeron N5105 processor and 4GB of RAM. At the back you'll find two 2.5GbE ports, along with two of the NAS's three USB-A 3.2 Gen 2 sockets – the other one is easily accessed at the front.

The NAS can mount up to four 3.5in or 2.5in SATA disks in various RAID configurations including RAID5, 6 and 10. Unusually, it also has four NVMe slots. You could configure the AS5404T with a four-SSD RAID5 volume, alongside a slower disk-based storage pool. Alternatively, you could use an SSD cache to accelerate disk performance, or compromise with one or two SSDs on cache duty and others serving as a fast volume.

You can upgrade the enclosure's installed RAM up to 16GB, though you'll have to remove the 4GB it comes with. If you need to add storage, you can do so with up to three Asustor AS6004U expanders, allowing for a total 16 disks. Asustor says this NAS can hit maximum read and write speeds of 599MB/sec, but you'll need to be using both network ports for that.

We're not wild about this unit's physical setup: there's tool-less access for 3.5in disks, but the caddies release with a horrific snapping sound that had us checking to confirm we hadn't broken the catches. The caddy clips are hard to remove, too. You'll need a screwdriver to open the case and access the NVMe slots, but the SSDs themselves simply clip into place.

We configured the AS5404T with four 1TB hard disks in a RAID5 array and two 1TB WD Black SSDs configured as a separate RAID1 volume. Unusually among modern NAS servers, Asustor's operating system defaults to the EXT4 file system, though Btrfs is an option. This NAS insists on synchronising new RAID1 arrays, but at least with our SSDs the process completed within an hour.

Connected via a single 2.5GbE connection, the AS5404T got off to an impressive start. It performed strongly through the ATTO disk benchmark, recording much quicker data rates than 1GbE competitors. With 16KB and 2MB file operations, it also showed a clean pair of heels to 2.5GbE rivals from QNAP. Things were far less impressive with the PCMark 10 Data Drive benchmark, however, on which the AS5404T was one of a few NAS enclosures we tested to record an inexplicably low score. We always confirm real-world data speeds with simple Windows file copies, however, and here the AS5404T was supreme, managing 85MB/sec when writing 11GB of files.

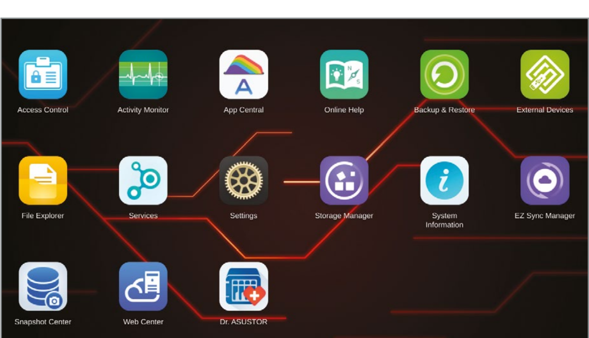


ABOVE This is a refreshing-looking NAS, especially if you love bright lights

PC PRO LABS WINNER



LEFT The Nimbustor 4 provides blistering performance speeds



BELOW Asustor's ADM operating system is certainly comprehensive

Performance was consistent when we tested its SSD storage, giving near-identical ATTO results with an SSD volume, and again when using SSD caching. Cached disk write speeds increased slightly in our file-copy test, although read speeds actually went down a little. We also recorded similar performances when we reinstalled this NAS with two Synology 4TB disks.

Asustor's ADM operating system is comprehensive and easy to use, though we did spot a couple of oddities in this test. Most significantly, the AS5404T couldn't be browsed from either a Chromebook or our Windows 11 test PC unless we turned on SMB1, although its shares could be accessed without it – so long as we entered the drive path by name.

One of the Nimbustor's strongest points is Asustor's App Central, which at the time of writing offered an incredible 272 apps, spanning networking, surveillance, productivity and entertainment. If you're chiefly interested in the latter, an HDMI port gives you a way to view multimedia content on an attached screen, but you can organise and serve photos or other media through the likes of Plex.

Don't let this NAS server's media talents put you off if you're buying for business, however. With blistering performance even when configured with two disks, the AS5404T is a solid starting package for a small business with big plans. If your micro office goes macro, you can add more disks, accelerate it with SSDs, beef up the memory, and even connect another enclosure. It's our Labs Winner.



QNAP TS-264

The TS-264 combines strong specifications and performance for a reasonable price

SCORE ★★★★☆

PRICE £333 (£400 inc VAT) from morecoco.co.uk

QNAP makes so many NAS enclosures that it can be hard to place specific models within the range. The TS-264 comes under the "Mid-range First Choice" bracket, which is QNAP's way of saying it's intended for small offices, homes and micro businesses. The "2" tells you this is a two-bay device, accepting up to two 3.5in or 2.5in drives.

Inside there are NVMe slots capable of accepting up to two 2TB SSDs, which can be used as storage or an SSD cache for the hard disks. QNAP pairs an Intel Celeron N5095 processor with 8MB of onboard RAM, which can't be further upgraded. At the back you'll find an HDMI socket, two 2.5GbE connectors, two USB-A 2 ports and a USB-A 3.2 Gen 2 port, with another Gen 2 socket on the front panel.

That's not at all bad for this price, but if needed you can upgrade with a dual-port PCI-E 10GbE network card. There's also support for various tower and rackmount storage expansion units, some of which require a mini SAS connector card that takes up the PCI-E slot.

In theory you can set up this NAS entirely without tools, but you'll struggle to fit NVMe drives without taking off the side panel, which requires a screwdriver. Even with it removed, the two slots are partially obstructed by the hard drive cage, making it hard to insert SSDs. Put it all back together and you can run Qfinder Pro to locate the NAS on your network, connect to its web admin interface and begin configuring QNAP's QTS operating system.

While QTS is generally excellent, it feels more technical and less slick than some rivals – particularly Synology's DSM software. It's great to have the choice between thick and thin provisioning, or using a more conventional static disk volume, but this does complicate things compared to its great rival. If using NVMe drives, you'll need to provide their physical security ID (PSID) number to securely erase them in the setup process, so it's a good idea to photograph them in situ before you put the case back on.

We loaded up the TS-264 with 14TB and 12TB NAS disks and two 1TB NVMe SSDs provided by WD, initially configuring these as two separate RAID1 volumes formatted with Btrfs (you can choose EXT4 if you prefer). Over a single 2.5GbE connection, it recorded competitive PCMark 10 Data Drive scores of 487 for the disk performance and 482 for SSDs. In ATTO Disk Benchmark, the TS-264 was level with competing two-bay enclosures for 4KB and 16KB file operations, but some distance ahead for 2MB files thanks to its faster network connection.



ABOVE The gold and black TS-264 may not look businesslike, but it's happy to work



LEFT QNAP's TS-264 is packed with ports, including two 2.5GbE connectors

Applying the settings

This process may take several minutes depending on the system hardware and hard drive capacity.

52%

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BELOW The QTS operating system is capable of handling any task

File-copy tests confirmed that the TS-264 is fast in real-world use, but the margin over 1GbE devices wasn't as great as we were expecting. That said, with disk caching configured this NAS put a little more daylight between itself and the 1GbE competition, particularly when copying larger files.

QTS is full of usability and connectivity features, including myQNAPcloud, which makes it easy to access and manage the NAS remotely. You'll also find a wide range of high-quality apps in the AppCenter – we counted 107, spanning content management, dev tools, security, networking and entertainment. Unlike the home-focused TS-233 (*see p90*) you get a full suite of surveillance apps including QVR Pro, and extensions covering face recognition and even automated door access.

Despite its diminutive size, the TS-264 makes sense for demanding users. Like other QNAP NAS enclosures, it can act as a DHCP, web or proxy server, and even a domain controller. Other apps let you configure it as a proxy, web or backup server, and even to host and manage containers. Its ability to scale and upgrade is also a bonus, although it's not badly specified out of the box.

While we wouldn't choose this NAS as a starting point for a small business, it is a good choice as a home NAS if you'll be using it for both work and entertainment. The TS-264 has the grunt to handle media serving and transcoding, while its twin network interfaces can be bonded to preserve network speeds as you gain users.



QNAP TS-253E

The TS-253E is a sensible business NAS that's ideal for rolling out to multiple small offices

SCORE ★★★★★

PRICE £423 (£507 inc VAT) from amazon.co.uk

Many cheaper NAS enclosures must appeal to the crossover between home power users and the lower end of the business market. QNAP's TS-253E has its sights set chiefly on the latter. It's a two-bay NAS, capable of accepting 3.5in or 2.5in SATA disks, and packing a further two slots for NVMe SSDs. QNAP markets the TS-253E as a long-term model, which it says will be sold and supported up until 2029. That makes it ideal for businesses intending to roll it out in a standard, easily supported configuration across multiple workgroups, outlets or branch offices.

The TS-253E has a similar spec to QNAP's TS-264 (*see p85*), but it makes do with a less sprightly Intel Celeron J6412 processor. This is paired with 8GB of onboard RAM, which unfortunately can't be upgraded. At the back you'll find dual 2.5GbE network ports and two 4K-capable HDMI sockets, making this NAS quite suitable for use as a surveillance centre. There are four USB-A sockets, split equally between USB 2 and USB 3.2 Gen 2, with one of the faster ports on the front panel.

If you're rolling out multiple TS-253E devices, you'll appreciate its lockable drive caddies, which are tool-free provided you're installing 3.5in hard disks. It's more of a faff to fit NVMe drives, the slots for which are under the main cover. This is secured by screws, as are the SSDs themselves. We recommend you keep a photo of the drives as installed, as you'll need their 32-digit PSID number before you can securely erase them.

We configured the TS-253E with two 1TB NVMe drives, and 14TB and 12TB hard disks provided by WD. In both cases we chose RAID1 for data redundancy and formatted with the Btrfs file system, although you can select EXT4. Connected over a single 2.5GbE port, we were surprised to find the TS-253E was a little faster than the TS-264 across most of our tests. This was particularly noticeable in ATTO Disk Benchmark, particularly with middling 16KB file sizes.

This NAS's disk array notched up 584 in the PCMark 10 Data Drive benchmark; the highest score in this group. Its flash volume was even faster, but on ATTO Disk Benchmark its flash performance was more in line with the other 2.5GbE NAS devices we tested. Finally, the TS-253E was among the faster units to complete our Windows file copy test, suggesting that its strong benchmark scores translate into real-world performance.

That's a good thing if you're using the TS-253E as a network server in a small business. Here, bonding its network ports could potentially double its peak data throughput across multiple users, although individual connections would still be limited to the 283MB/sec or so possible over 2.5GbE. If that's not enough, you can upgrade it with a USB to 5GbE adapter.

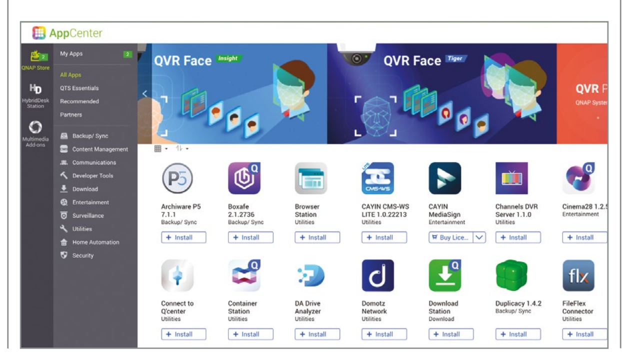


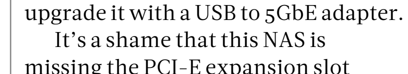
ABOVE Compact and business-like, the TS-253E is all about functionality



LEFT You'll need tools to get at the NVMe slots and insert SSDs

BELOW The 106 apps available through the QTS AppCenter cover most business needs





It's a shame that this NAS is missing the PCI-E expansion slot found on many other QNAP devices; that means you can't upgrade with 10GbE networking or add more NVMe slots. Still, QNAP offers a range of USB-connected storage expanders, using which you could take the TS-253E to a maximum of 18 drives.

All of this would be for nothing if the TS-253E had rubbish software, but fortunately it comes with QNAP's Linux-based QTS operating system. This isn't the friendliest choice – particularly when it comes to setting up disk volumes – but it's extremely comprehensive. In addition to built-in functionality covering network basics such as DHCP, the 106 apps available through AppCenter cover just about anything a small business would want, along with a strong selection of media servers and transcoders.

Like other HDMI-equipped QNAP enclosures, you can turn the TS-253E into a PC via QNAP's HybridDesk Station, which also helps you install a range of multimedia, surveillance and browsing apps. While you probably wouldn't want it as your sole computer, it could be a way to support surveillance or meeting room requirements in a small business without investing in further hardware.

The TS-253E is expensive for a two-bay NAS enclosure and, for home users, it's not really worth it when the TS-264 costs around £100 less. However, if you're buying for business, and particularly if you've got an eye on minimising support headaches across a group of premises, this is an excellent choice.



Synology DiskStation DS423+

The DS423+ has attractive small business features and a good price, with only a lack of 2.5GbE holding it back

SCORE ★★★★☆

PRICE £396 (£475 inc VAT) from ballicom.co.uk

Synology's DiskStation DS423+ is a home and small office NAS, offering four SATA drive bays, and supporting up to a whopping 72TB of storage. With a Celeron J4125 processor and 2GB of RAM, it's similarly specified to the two-bay DS224+ (*see p92*). Unfortunately, that extends to its dual gigabit Ethernet ports, which look like a mis-step when many competitors now offer 2.5GbE. Synology hasn't been overly generous when it comes to other ports, either. You won't find HDMI here, and there are only two USB-A 3.2 ports – and they're the slower, 5Gbits/sec Gen 1.

The DS423+ does have a trick up its sleeve in the shape of two NVMe SSD slots. Drives in these can be configured as a cache for hard disk volumes, used to create a flash storage pool, or split between the two roles. A single SSD doesn't offer data redundancy, though, so you'll need to use both slots for caching if you want to accelerate disk writes as well as reads.

This is one of the easiest NAS devices we've tested when it comes to setup. Its lockable caddies are tool-less for 3.5in disks. It's also quicker and easier than the norm to access its NVMe slots – you simply flip the enclosure on its back, pop open two small covers and click the drives in. Even the memory expansion slot can be accessed without tools.

We initially configured this NAS with four 1TB disks configured in a RAID5 array. While Synology, like other manufacturers, is usually quite relaxed about the brand of hard disk you fit, this doesn't extend to NVM drives. The DS423+ was happy to use two unapproved 1TB WD Black drives as a disk cache, but you can use only approved SSDs to create a storage pool. At the time of our review there were just four approved SSDs on the compatibility list: they're all made by Synology and have either 400GB or 800GB capacities, limiting you to an 800GB maximum for a flash volume with data redundancy.

With or without disk caching, this isn't a particularly fast NAS. It lined up closely with other gigabit Ethernet devices in ATTO Disk Benchmark, hitting peak transfer rates of 110MB/sec (write) and 113MB/sec (read). It scored a fair 348 in the PCMark 10 Data Drive benchmark, and managed 59MB/sec writes and 46MB/sec reads in our 11GB Windows file copy test. We retested it when configured with two large WD disks, but its performance was essentially unchanged.

It's fair to point out that disk caches become more effective over time, and our benchmarks don't particularly show the benefits. It's also worth noting that port bonding – in which the NAS balances the load across both Ethernet ports – would help the DS423+ deliver a greater throughput in a multi-user setup. Even so, no single user would see data transfer rates above the 113MB/sec gigabit Ethernet limit, which puts this NAS at a disadvantage when compared with 2.5GbE rivals such as QNAP's TS-464 (see p85).

That's a shame, because it's simple to manage Synology NAS boxes. DSM manages to combine user friendliness with plenty of functionality, spanning networking, security and convenience features such as QuickConnect, which lets you access the NAS remotely. You can bolt on extras through the Package Center, which at the time of writing offered 107 apps.

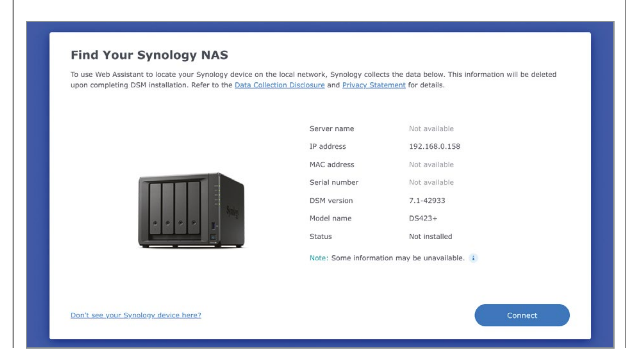
Highlights include strong third-party apps such as Plex Media Center, WordPress and various developer tools, but also Synology's own software, which tends to focus on business requirements. Examples include Surveillance Station, Synology Mail Server and even the Synology Office suite. There are also tools such as Synology High Availability, which lets you use a second NAS to provide failover cover should the active server fail.

In most ways, the DS423+ is a great product for small businesses, and if speed isn't a major concern then it's a good choice. However, with only 1GbE network interfaces – and no expansion slot to upgrade them – it could become a bottleneck in a growing business, particularly one that needs to back up or work with large volumes of data. If that's likely to be you, we'd advise stretching your budget to get the upgradability of Synology's DS923+ (*see p92*) or the better specification of Asustor's Nimbustor 4 Gen2 (*see p84*).



ABOVE Visible, lockable disk caddies tell you the DS423+ is cut out for business

LEFT The dual Ethernet ports are sadly only of the gigabit variety



BELOW Synology's excellent software lifts all of its products above rivals

TerraMaster F4-424

This four-bay NAS is fast and nicely designed, but TerraMaster is playing catch-up for software

SCORE ★★★☆☆

PRICE £400 (£480 inc VAT)
from amazon.co.uk

TerraMaster's F4-424 looks exactly like a four-bay version of the disappointing F2-212 (*see p93*), but don't be fooled. It's a thoroughly upgraded device, featuring an Intel N95 processor – one of the more powerful CPUs that you'll find in a NAS at this level. It's paired with 8GB of DDR5 RAM, which is handy enough, but you can upgrade to a maximum 32GB, though doing so means binning the 8GB SODIMM already fitted.

Despite keen pricing, the F4-424 is a nicely designed product. Its four tool-less drive caddies slide in and out smoothly, while at the rear there's a single 12cm fan – quieter and more effective than two smaller fans. Here you'll also find an HDMI port, along with USB-C and USB-A 3.2 Gen 2 connectors. As you'd hope, there are dual 2.5GbE network ports, too.

The design isn't perfect, though. While the front panel is uncluttered, that's because there are no buttons or USB ports, and the status and drive LEDs are rather small. Perhaps more annoyingly, the power button is at the rear where it will be hard to reach if you're putting the NAS on shelving. You'll need a screwdriver to remove the side panel covering the single memory and dual NVMe slots. The latter are secured by two knurled screws you can turn by hand.

We configured this NAS with four 1TB disks and two 1TB WD Black NVMe SSDs. Initially we set the former up as a RAID5 volume and the latter as a fast RAID1 drive, testing them separately. We then configured the SSDs as a read/write cache and repeated our benchmarks. Even with no caching, the F4-424 was stunningly fast in ATTO Disk Benchmark. It hit the maximum possible 283MB/sec over 2.5GbE during 2MB operations, but we were more impressed by its 4KB and 16KB performance, which was in a different league to the other mid-range NAS units on test.



ABOVE The F4-424's front is uncluttered, but you'll need to reach round the back to turn it on

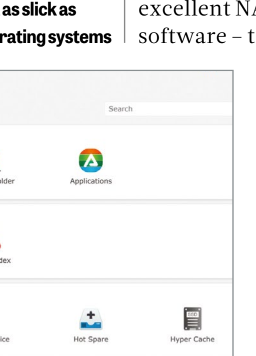
However, this was one of four NAS in this group to underperform in the PCMark 10 Data Drive benchmark. We retried this test in several configurations without scoring more than 169 points – less than a third of what we'd expect from the drive's specification. However, it performed strongly on real-world file copies, writing at 78MB/sec in our test.

LEFT There are dual 2.5GbE network ports at the rear

The F4-424 could be ideal for demanding office use, then, but not everything went smoothly in our test. When we tried to configure it with a pair of 12 and 14TB disks, it began warning us that the RAID1 array was degraded, even though the drives' status was displayed as "good". It wasn't evident how to clear the error, and the warning buzzer didn't stop until we'd deleted the array and started building a new one. We went through the same issue twice before successfully using the disks. At one point the NAS disappeared from the Windows network; on investigation the SMB service had turned itself off.

Even putting these issues aside, it's hard to love TerraMaster's TOS operating system, despite the mournful pug staring at you from its desktop. While it's easy to set up, it isn't as slick as competing operating systems such as Synology's DSM. It manages to combine a clunky user experience with a lack of basic functionality – such as an ETA for disk operations like synchronisation. We didn't get on with the Resource Monitor, or more specifically the draggable sliders on the timeline that seemed intent on resetting just before we got the level of zoom we wanted.

Still, the App Center offers a decent collection of backup, entertainment, dev, virtualisation and web-hosting software. There were only 59 apps at the time of our review, although many more were available via the TerraMaster Community. The F4-424 felt fast and responsive at all times, even when we started loading it up with software.



BELOW TerraMaster's TOS isn't as slick as rival operating systems

For the most part, this feels like an excellent NAS, let down by sub-par software – though it's worth noting that the next release of TOS, version 6, promises many improvements and is nearing release. Based on our testing this NAS could perform well if you transfer a lot of small files – if you're planning to use it as a Git repository, for example. However, if you're after a powerful all-rounder, the Asustor Nimbustor 4 Gen2 (*see p84*) is a better bet.





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Asustor Flashstor 6 FS6706T

This all-flash home NAS is very quick, but its lack of flexibility means we'd lean towards the Nimbustor 4

SCORE ★★★★☆

PRICE £374 (£449 inc VAT) from amazon.co.uk

As its name suggests, the Flashstor 6 is an all-flash NAS enclosure, with space for up to six NVMe SSDs. It's aimed mostly at enthusiast use in the home, so comes with useful multimedia features such as HDMI and S/PDIF audio outputs. It's well specified elsewhere, too, with a pair of 2.5GbE network ports, two USB-A 3.2 Gen 2 ports and two USB-A 2 ports. The supplied 4GB of memory is upgradable to 16GB.

It doesn't have any hard disk slots, but you could add bulk storage with up to two Asustor AS6004U expansion units, each accepting up to four 3.5in SATA drives. If six SSDs isn't enough, for £744 inc VAT (from Amazon) you could choose the 12-slot Flashstor 12, which is otherwise broadly the same.



ABOVE The Flashstor 6 looks more like a wireless router than a NAS drive

Most NAS enclosures offer tool-free setup, but you'll need a screwdriver to pop off the cover here, while each NVMe just clips in. The FS6706T supports the same range of RAID formats you'd expect from any six-bay device, though we tested it using two 1TB WD Black SSDs, arranged in a RAID1 array. Asustor's ADM software defaults to the EXT4 file system, but you can choose Btrfs.

It will come as no surprise that the FS6706T performed strongly. We tested it with a single 2.5GbE connection, over which it comfortably outpaced any NAS limited by a 1GbE connection. That said, it didn't eclipse disk-based 2.5GbE devices, with Asustor's own Nimbustor 4 Gen2 (*see p84*) proving slightly quicker. As with the Nimbustor 4, this NAS was inexplicably slow on the PCMark 10 Data Drive benchmark, but made up for it with quick real-world copy times in Windows 11. It's worth pointing out that this device might have been even faster if we'd been able to test it with a six-drive RAID5 array.

While you could use this NAS as the hub for a small business, it's far more likely to see use as a multimedia store and server for demanding home users and gamers. It's well suited to this role, with Asustor's App Central offering an amazing 273 apps, spanning everything including content, download and media management, along with productivity, surveillance and streaming.

This NAS has the horsepower to transcode video content without getting bogged down, so it's even suitable for a household with a few power users. However, its lack of disk support makes it less flexible than the Nimbustor 4 Gen2, which accepts up to four disks and four NVMe SSDs, and proved just as fast in our tests. In most cases, we'd pay the extra £80 for that.



QNAP TS-233

A compact two-bay NAS that covers the basics and is good value, but its lack of oomph is telling elsewhere

SCORE ★★★☆☆

PRICE £158 (£190 inc VAT) from amazon.co.uk

QNAP's TS-233 is an entry-level two-bay NAS, aimed squarely at home users who want the extra reassurance of data redundancy. It's probably the most compact two-drive enclosure we've seen; a diminutive box you could easily slip on to a bookshelf or tuck behind a desk. While it's a little taller than the norm, it's at least a couple of centimetres narrower than many of its rivals.

The spec here is typical for an entry-level device. At the back there's a single gigabit Ethernet port, with a lone USB-A 3.2 at the front socket – a button sits just above for triggering one-touch backups of inserted drives. Inside there's a quad-core ARM Cortex processor running at 2GHz, paired with 2GB of non-expandable memory.



ABOVE Unusually compact, the TS-233 can fit into relatively shallow spaces



The TS-233 has an almost tool-less setup; you'll need a screwdriver to remove the screw holding its enclosure shut. With the case open it's easy to drop a couple of drives into the 3.5in caddies and snap the side locks on, or to secure 2.5in drives with the supplied screws.

QNAP's QTS interface may not be the easiest to use, but its setup wizard guides you through creating a storage pool and drive volume. As you'd expect, there's support for either RAID0 or RAID1, with the latter providing data protection at the expense of halving the available drive space. QTS suggests Btrfs as the default file system, but EXT4 is available if you prefer.

This may be an entry-level device, but it offers secure remote access and snapshot protection. You can expand the functionality of the TS-233 with apps, but at the time of writing only 74 were available, compared to 107 for the more powerful TS-264 (*see p85*). Most of the missing utilities relate to networking and surveillance, but the TS-233 still offers a useful selection of entertainment apps including Plex, as well as QNAP's own Music Station and Photo Station apps.

Unfortunately, the TS-233's performance is strictly entry level, with its single GbE port limiting speeds to a claimed 103MB/sec write and 114MB/sec for reads, although we found its peak write speeds to be 113MB/sec in practice. It's particularly slow when dealing with small files, managing only about 20MB/sec for 4KB operations in ATTO Disk Benchmark. It bumbled along around that speed in our file-copy test, too, comfortably the slowest device here. As such, the TS-233 is best seen as a no-frills device for sharing and the safe keeping of data in the home. Luckily, it's fairly priced for that role.

QNAP TS-464

QNAP's TS-464 looks good, performs well, and has plenty of scope to grow with your demands

SCORE ★★★★☆

PRICE £484 (£581 inc VAT)
from ebuyer.com



The QNAP TS-464 is a mid-range, four-bay NAS enclosure that supports 3.5in and 2.5in SATA drives. It's otherwise essentially identical to the two-bay TS-264 (*see p85*), which is no bad thing: it means a strong specification that includes two 2.5GbE network ports, an Intel Celeron N5095 processor and 8GB of RAM. Open it up and you'll also find NVMe slots for up to two 2TB SSDs. There's scope for upgrades, too, in the shape of a dual-port PCI-E 10GbE network card and multiple expansion drive options.

The TS-464 supports the full range of disk configurations you'd expect in a four-bay NAS, including RAID5, 6 and 10. You can also migrate from a two-disk RAID1 array to three- or four-disk RAID5, giving you an upgrade path if your storage needs grow over time. You can use inserted SSDs either as a fast storage pool, or to cache hard disks. It's possible to use one SSD for each job but, to protect data, only read caching is available when using a single NVMe.

We first configured the TS-464 with four 1TB disks in a RAID5 array, and two 1TB WD Black NVMe SSDs as a separate RAID1 volume. You need to be dextrous to insert NVMe drives in this enclosure, and we recommend you photograph them in place as you'll need the PSID later to securely format them.

ABOVE The QNAP TS-464 looks particularly snazzy in black and gold



As we expected, the TS-464's four-disk configuration gave it a moderate performance advantage over the TS-264. This was noticeable in the ATTO Disk Benchmark, where it was faster right up to the point where both enclosures hit the 2.5GbE bandwidth limit, and in the PCMark 10 Data Disk benchmark. Oddly, it performed marginally slower when we timed it on large Windows file copies, although both enclosures performed similarly to each other when it came to flash storage speeds.

QNAP's QTS operating system is one of the most comprehensive around, though it's less intuitive than Synology's. Between built-in QTS functionality and the 107 apps available through the App Center, you can configure the TS-464 for most network functions, with the only obvious omissions being the lack of mail server or office software. It's well served for other apps, particularly media serving and surveillance.

Overall this is a great choice for a home or micro business, particularly if you think your needs might grow in the future, although QNAP charges quite a premium over the TS-264 for those extra disk bays. That said, the Asustor Nimbustor 4 Gen2 is cheaper, a little faster, and it has four NVMe slots, making it a slightly better buy.

Synology DiskStation DS223

The DiskStation DS223 is a solid entry-level NAS, but enthusiasts and businesses should look elsewhere

SCORE ★★★☆☆

PRICE £204 (£244 inc VAT)
from ballicom.co.uk



The DS223 sits almost at the bottom of Synology's huge NAS range, with only the single-slot DS124 and the more basic two-slot DS223j variant sitting below it. Accordingly, it's not particularly well specified, with only two SATA drive bays and no NVMe slots. There's 2GB of RAM onboard, which can't be upgraded, while all the processing work is done by a lowly four-core Realtek CPU clocked at 1.7GHz. Perhaps just as significantly, this NAS has just a single 1GbE network port, immediately putting it at a disadvantage to 2.5GbE devices when it comes to fast file serving.

Still, the DS223 is designed and built with Synology's usual quality. Pull off the front panel and its two drive caddies slide in and out smoothly – they're tool-less for 3.5in disks, but you'll need to screw 2.5in devices in place. We fitted two 4TB Synology disks, turned the NAS on, then connected to its web interface to create a RAID1 array and format it with the Btrfs file system.

While other NAS manufacturers continue to improve their software, Synology remains the master. Its DiskStation Manager (DSM) operating system strikes almost the perfect balance between functionality and ease of use. Storage Manager makes it intuitive to create and manage storage pools and volumes, while all the network, user and other settings are gathered together in Control Panel.

ABOVE This is a compact and smart NAS that's easy to install and configure



You can enhance and add to the DS223's functionality through the Package Center, which at the time of our review offered 107 apps covering a range of multimedia, backup, business and communication roles. However, this NAS drive's modest power means it could struggle to run multiple demanding apps at once.

This NAS was an underwhelming performer in our tests anyway, even compared to other devices limited to a 1GbE interface. In ATTO Disk Benchmark it was around 20% slower than other Synology NAS enclosures for a 4KB file size, and about 10% slower for 16KB files. Even though it caught up when moving 2MB files, it still managed only 111MB/sec writes and 113MB/sec reads – about the maximum possible over gigabit Ethernet. Surprisingly, however, the DS223 was quite competitive when writing files from a Windows 11 PC.

We love this NAS drive's simplicity and comparative ease of use, but it's significantly more expensive than QNAP's TS-233. It's quicker, but if speed is important we'd recommend spending more on a 2.5GbE alternative such as the QNAP TS-264.



Synology DiskStation DS224+

The DiskStation DS224+ is a solid home NAS, but it will leave enthusiasts wanting more

SCORE ★★★☆☆

PRICE £261 (£313 inc VAT)
from ballicom.co.uk



At first glance Synology's DiskStation DS224+ looks much like the cheaper DS223 (*see p91*). It's the same colour and dimensions, and has the same button, port and LED layout on the front panel. Snoop around a bit and you'll spot a significant improvement, though: this NAS has dual 1GbE ports, which can be used to offer faster throughput and failover support.

There's a bigger upgrade inside, where the DS224+ has an Intel Celeron J4125 processor rather than the limp Realtek in the DS223. Its 2GB of memory is also upgradable to 6GB via a spare slot, accessible without tools if you remove the drive caddies. Synology talks up the enhanced performance of the DS224+ when compared to previous-generation devices, and this processor should certainly help if you're intending to use it as a media server in the home.

It's usually easy to set up Synology devices, and the DS224+ obliges with tool-free caddies for 3.5in SATA drives – as with other contenders here, you'll need to screw in 2.5in disks. You can quickly track down any local DiskStations via the Web Assistant. Once you're into the web interface, it's simple to install Synology's DSM software and configure the storage.

ABOVE The DS224+ is compact and looks smart enough for any home office



We added two 4TB disks provided by Synology, configuring them in a RAID1 array and formatting them with Btrfs; EXT4 is available if needed. The DS224+ delivered on its improved specifications, outpacing the DS223 in 4KB and 16KB file operations in ATTO Disk Benchmark. It was also a little quicker to write files in our Windows file copy test, hitting 60MB/sec compared to 52MB/sec for the DS223.

This is something of a distraction from the fact that this NAS is throttled by its gigabit Ethernet ports. In our tests it sustained a maximum transfer speed of 113MB/sec. In comparison, 2.5GbE connections can deliver up to 283MB/sec. It's easy to bond the two network interfaces, but this won't improve speeds to a single client; instead it helps increase bandwidth when there are multiple users.

Synology pitches this NAS as a data storage device for edge deployments, which is likely to mean home workers and micro offices. Synology's software is certainly more than equal to the role, combining a solid feature set with 107 apps available through Package Center. Perhaps this NAS's slower Ethernet won't be a problem for home workers primarily connecting via Wi-Fi, but if you have several users we'd recommend paying more for an alternative with a 2.5GbE interface.

Synology DiskStation DS923+

The DiskStation DS923+ is a sturdy building block for a small business network, despite its 1GbE ports

SCORE ★★★★☆

PRICE £450 (£540 inc VAT)
from printerland.co.uk



Synology's DS923+ is the only NAS in this group that we've reviewed before. It won our last external storage group test (*see issue 345, p76*), so we wanted to see how it compared to a new crop of rivals. Those familiar with NAS terminology might be thrown by the "9" in the model name. In fact, this is a four-bay device, which you can expand with a five-bay enclosure for a nine-disk maximum. Although it looks identical to the DS423+, it's significantly better specified. For a start, there's a powerful AMD Ryzen 1600 processor, paired with 4GB of RAM that you can upgrade to a hefty 32GB.

This NAS has two NVMe slots. At its back you'll find one of the two USB-A 3.2 Gen 1 ports, along with an eSATA connector for the expansion unit. Like many competitors, the DS923+ has a dedicated copy button above its front panel USB port, so it's simple to back up inserted USB drives.

Given the potential role of this NAS as a busy file server, the presence of two gigabit Ethernet ports is a disappointment when most competitors now have significantly faster 2.5GbE ports. You can upgrade with a PCI-E card supporting up to 10GbE, but it has only a single port.

We tested the DS423+ with four 1TB disks in a RAID5 array. Even without SSD caching, it actually delivered better results than when we last reviewed it. However, we recorded maximum read and write speeds of 113MB/sec; it's no coincidence that this is the maximum transfer rate for gigabit networking. We obtained similar benchmark results with SSD caching enabled, and when we retested with just two disks.

ABOVE Lockable drive bays mark this out as a business-focused NAS





Unfortunately, that undermines the DS923+ a little. Competing 2.5GbE devices can copy large files at about two-and-a-half times the speed, and the best we've tested completed our real-world Windows copy tests about 30-35% more quickly. If you're choosing a NAS to serve data in a busy organisation – and particularly one handling large multimedia files – you should budget around £150 for the network upgrade.

Happily, the DS923+ remains nigh-on fantastic in other respects. It's easy to set up, and truly tool-less provided you're not fitting 2.5in disks. Synology's DSM software remains our favourite operating system for small business NAS devices, combining comparative ease of use with a strong set of standard features and apps. Overall, the DS923+ is a great choice if you want a powerful NAS with plenty of upgrade potential, but if speed is important from the outset we'd go with the Asustor Nimbustor 4 Gen2 (*see p84*).



TerraMaster F2-212

The F2-212 is an affordable NAS. Unfortunately, it's outclassed by other entry-level devices

SCORE ★★☆☆☆

PRICE £142 (£170 inc VAT)
from amazon.co.uk



TerraMaster's F2-212 is an entry-level NAS enclosure offering two 3.5in SATA drive bays. It's not especially well specified, pairing a lowly four-core Realtek processor with just one gigabyte of non-upgradable RAM. At the rear there's a single gigabit Ethernet port, along with one USB-A 3.2 Gen 1 and one USB-A 2 port.

Open the F2-212's plain packaging, however, and you're in for a pleasant surprise. This is a decent-looking NAS enclosure, with some nice finishing touches – we particularly appreciated the small TerraMaster tag near the connector end of the power supply cable, which helps you keep track of it among the cable spaghetti behind a typical desk. Its drive caddies are among the smoothest to remove and reinsert, and we managed to drop in two 3.5in SATA disks and get the NAS started in well under five minutes.

TerraMaster's setup wizard is relatively simple, offering the usual two-bay choice of RAID0, RAID1, JBOD and single-disk modes, and defaulting to the Btrfs file system; EXT4 is available if you want it.

We started configuring this NAS with 14TB and 12TB WD Red drives in a RAID1 configuration, which cast light on a few limitations. First, this isn't a particularly fast device, with the initial synchronisation barely inching along on such large drive sizes. Second, the TerraMaster Operating System (TOS) isn't the best for user experience, offering only a percentage completion and no ETA for this process. Ultimately we abandoned the configuration and opted for two 4TB Synology drives, but even these took the best part of a day to be synchronised.

ABOVE The F2-212 looks business-like, but it's really a device for basic home use



The delay allowed us to spend more time investigating TOS, which was on version 5 during our testing. It's a reasonable interface, but it doesn't have the polish of QNAP's QTS interface, let alone Synology's slick DiskStation Manager. It's also behind when it comes to apps. While it offers WordPress, Plex Media Server and Docker Manager, there were only 42 apps available overall at the time of our review. Three of TerraMaster's own apps were in beta, including Surveillance Manager. We should note that TOS6 is due for imminent release, and may offer improvements.

Once the RAID volume had been synchronised we could proceed with our performance testing, which was disappointing. The F2-212 was comparatively slow in the ATTO Disk Benchmark, and far slower to write files in Windows than all but other entry-level enclosures. Factoring that in, the QNAP TS-233 (*see p91*) is a better budget option, but we'd be inclined to spend more.

OWC Mercury Elite Pro Dual with 3-port USB hub

If you aren't set on network connectivity, this external disk enclosure offers speed and simplicity for less cash

SCORE ★★★☆☆

PRICE 4TB, £262 (£315 inc VAT)
from megamac.com



Every group test should have an odd one out, and in this case it's OWC's Mercury Elite Pro Dual. This desktop dual drive enclosure connects via USB-C, and supports two SATA disks in RAID0, RAID1 and JBOD configurations. We tested the version with an integrated, fully powered three-port USB hub, which could be ideal if you're looking for a simple way to dock a laptop or gain more storage. The host interface, the single USB-C and dual USB-A ports all support 10Gbits/sec speeds, theoretically allowing for 1,250MB/sec transfers.

You can buy the Mercury Elite Pro Dual as an empty enclosure, which will set you back around £130 exc VAT. OWC supplied us with the 4TB model, configured with two 2TB disks, but you can select it with up to 40TB of disk space or 8TB of flash storage. Note that the stated capacity is for RAID0, Span and JBOD modes; switch to RAID1 and you'll halve it.

OWC's desktop drives are ideal for demanding creative applications, and they're Mac-formatted by default. You'll need to install OWC's free Drive Guide utility to convert them for Windows use. If you buy with disks, the enclosure arrives configured for RAID0. It's quick and easy to change this using the four-position dial and "Set RAID" switch on the back, though you might want to use Device Manager to confirm which mode the device is in. Changing modes will wipe the disks, and before you can use them again you'll need to create a new partition.

ABOVE The Mercury Elite Pro Dual's metal case helps to dissipate heat



We configured the drive with a RAID1 array, and hit it with the same suite of tests we used for NAS drives. It outperformed almost every NAS we've tested for 4KB and 16KB operations in ATTO Disk Benchmark, but surprisingly it topped out at 204MB/sec writes and 212MB/sec reads – about 25% slower than the fastest 2.5GbE NAS enclosures. The PCMark 10 Data Drive benchmark told a similar story, with this drive's score of 550 slightly short of the best 584 we recorded from a NAS. Our real-world file-copying benchmark also followed this pattern.

This enclosure was substantially quicker in RAID0 mode, hitting a maximum of 391MB/sec when reading and 408MB/sec for writes. In theory, it should also have delivered roughly that read speed in RAID1 configuration; it's disappointing that it didn't. As a desktop storage device, this isn't really suitable for sharing on a network. However, if you want to add rapid storage to a PC – or an existing NAS – it's a decent choice.



How we test

This Labs focuses on home and small office NAS enclosures, so it was important to test them with a realistic setup. We chose a mid-spec Intel Core i5-1135G7 Windows 11 laptop with 16GB of RAM. We upgraded it with a USB-C to 2.5GbE adapter, and used a QSW-1108-8T switch kindly provided by QNAP.

We tested each NAS with the maximum number of disks fitted. For two-bay devices, we used two 4TB Synology Plus disks, and where possible tested again with a mismatched set comprising 12TB WD Red Plus and 14TB Red Pro NAS hard drives. On four-bay devices, we used four 1TB Seagate Barracuda disks, then re-tested using one of the two-disk pairings.

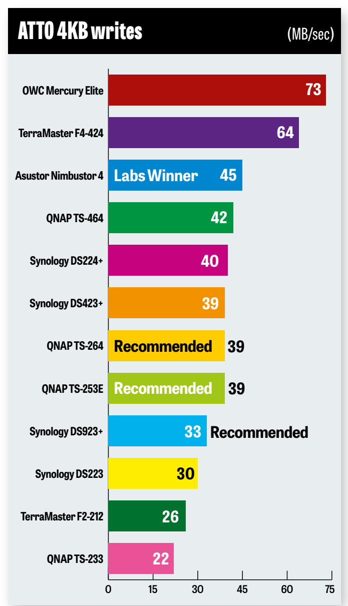
Where a NAS had NVMe slots, we added two WD Black 1TB SSDs and repeated our tests with them configured as a read-write cache. Where supported, we also configured and tested these as a standalone flash volume. With all disk and SSD arrays we used RAID 1 or RAID 5 for data redundancy, formatted with Btrfs, and waited for synchronisation tasks to complete before testing.

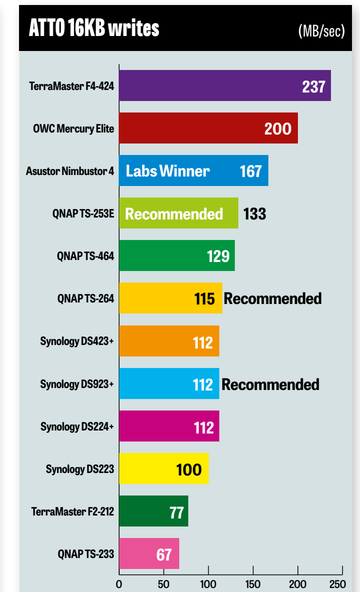
We tested transfer speeds with ATTO Disk Benchmark, looking particularly at 4KB, 16KB and larger 2MB file operations. We also ran the PCMark 10 Data Drive benchmark (supplied here purely for information as we didn't make speed judgements using this) and tested real-world performance with an 11GB Windows file copy. This 11,300-file test contained a single 8GB ISO file, nearly 2GB of photos and 10,000 small files averaging 140KB each.

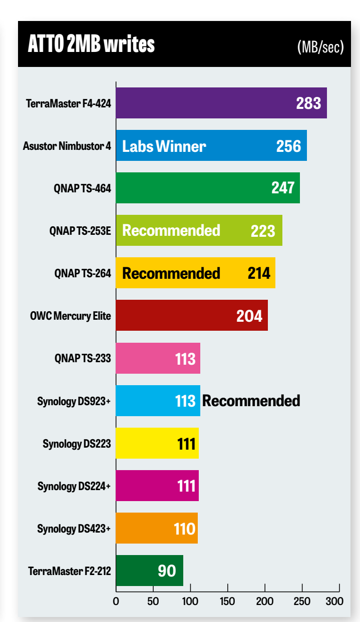
Finally, we installed various apps, including Plex Media Server, and checked how well each device coped when performing multiple tasks at once.

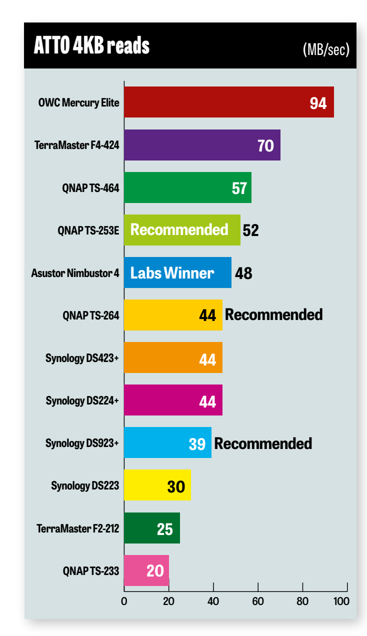
ABOVE We used a QNAP QSW-1108-8T switch to remove any bottlenecks during testing

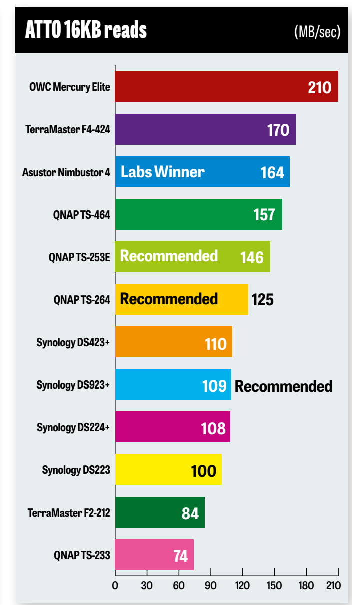
Results with hard disks

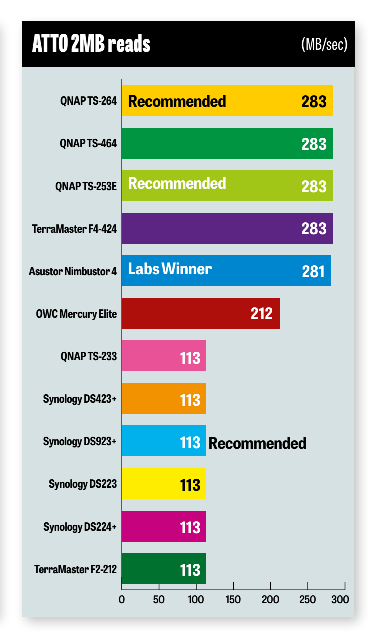


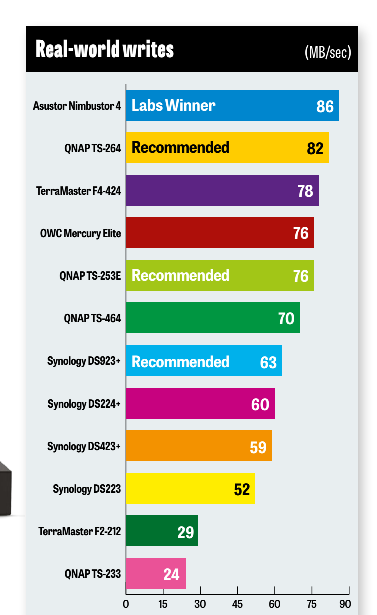


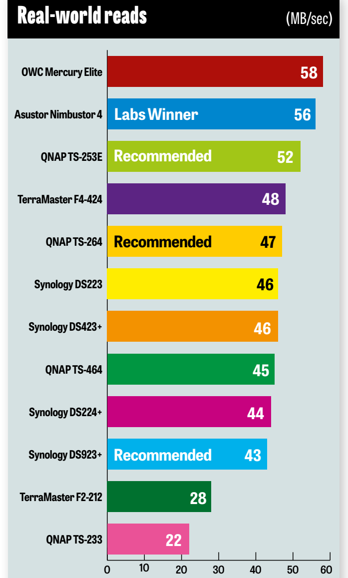


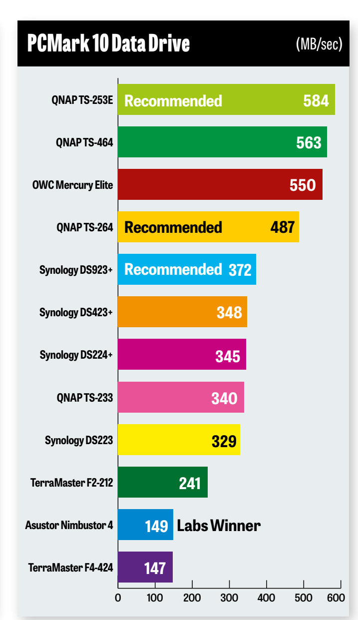






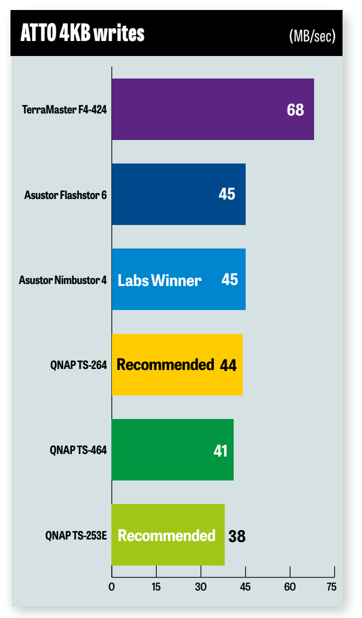


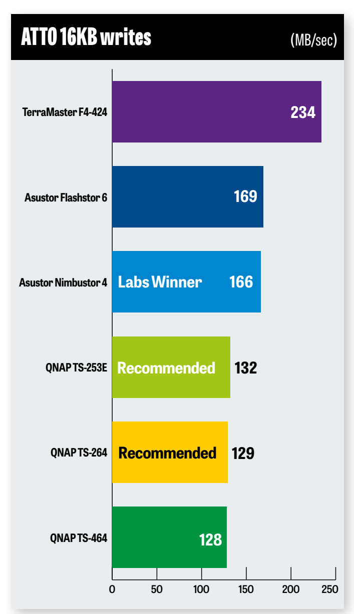


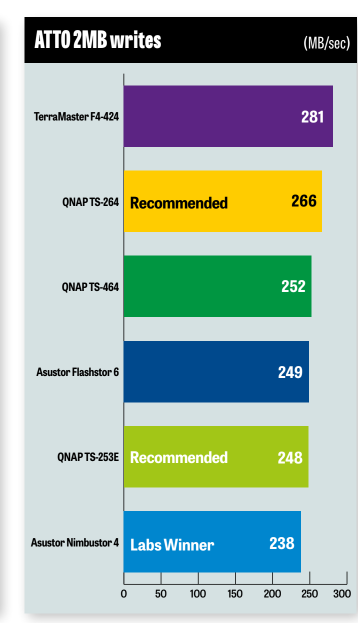


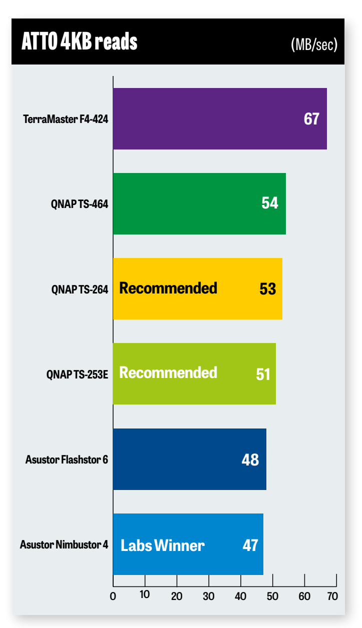


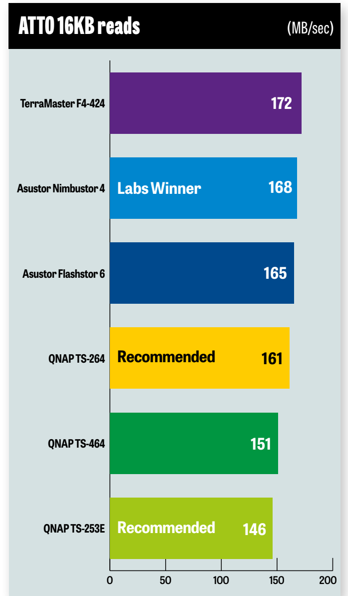
Results with SSDs

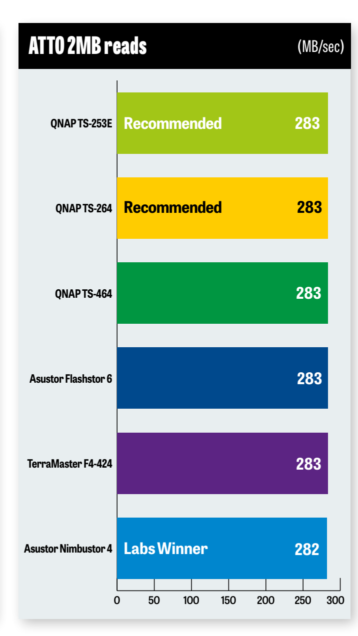


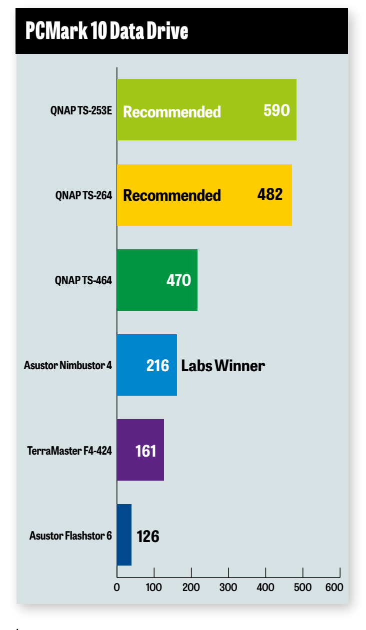


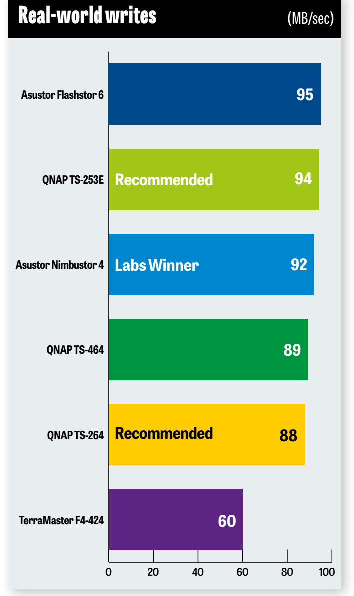


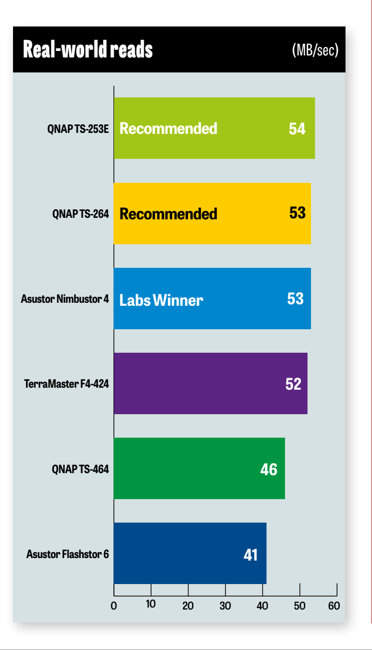












View from the Labs

In the real world, it isn't always amazing specifications that make the difference

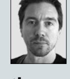
Sometimes specifications paint a very accurate picture. Take the Asustor Nimbustor 4 Gen2: it sounds fast on paper, and it proved so in practice.

Sometimes, however, specifications create the wrong impression. In theory, the OWC Mercury Elite Pro Dual can chuck data around at 1,250MB/sec. But connected to our computer, configured in a RAID1 array, it barely managed a sixth of that.

In this test, though, it became abundantly clear that one specification really does count. On every benchmark, almost without exception, devices with 2.5GbE network interfaces were significantly faster than those with plain old gigabit. On large files the difference is massive, with gigabit devices strangled to a maximum of around 113MB/sec while 2.5GbE NASes merrily went to 283MB/sec.

So how much does that matter? If you're buying for home, and particularly if your router and devices only support 1GbE, probably not at all. You won't see any difference with a 2.5GbE NAS unless you also upgrade your switch and network interfaces to exploit it. And even then, our file-copy results suggest the gains aren't life-changing.

But here we're focused more on small and home office users, for whom 2.5GbE is a cost-effective way to get a big boost in bandwidth. Even where individuals connect via gigabit or – shudder – Wi-Fi, having 2.5GbE on your NAS lets it serve more of them more quickly. So much so that it's become hard for us to strongly recommend any 1GbE NAS for an office, unless it can be upgraded. ●



Simon Handby has been writing about technology for 20 years, including a three-year stint at our former sister magazine *Computer Shopper*

The Network

Practical buying and strategic advice for IT managers and decision makers

Buyer's guide

Desktop scanners 2024

Digitise your archives, streamline your workflows and back up vital information all in one move with a professional scanner. Dave Mitchell explains what to look for

If a large proportion of your offices are occupied by ranks of filing cabinets then the move to digitisation is long overdue. The totally paperless office may be a myth, but businesses that significantly reduce their reliance on paper records can realise huge benefits such as increased productivity and big reductions in operating costs.

Offices are expensive to rent, so businesses can save hard cash by scanning documents and sending them to a secure storage facility instead of occupying valuable office floor space. Workflow efficiencies and customer experiences can be improved markedly because staff won't need to waste valuable time searching through filing cabinets looking for crucial invoices or sales records.

Scanning offers plenty of other benefits, too. A digital document management system will allow office staff and remote workers to easily share information with each other. Unlike paper, digital records are more secure and can be easily backed up and restored, and you can have a positive impact on the environment by ditching your printer fleet.

The good news for SMBs is there are plenty of fast and affordable scanners on today's market. In this month's guide, we test business-class desktop scanners from Brother, Canon, Epson and Xerox to help you make the right buying decision.

Well connected

The cheapest desktop scanners provide a USB port for direct connection to a host PC. This is a great choice if you want to centralise all scan operations in one location, but any savings could be offset by the need to dedicate the PC to scanning and document management functions.

Wired and wireless network scanners are only slightly more expensive and are more versatile as they don't require a host PC so can be placed in more convenient locations in the office. Access can also be more easily controlled by only allowing the software and network drivers to be installed on devices that are permitted to connect to the scanner.

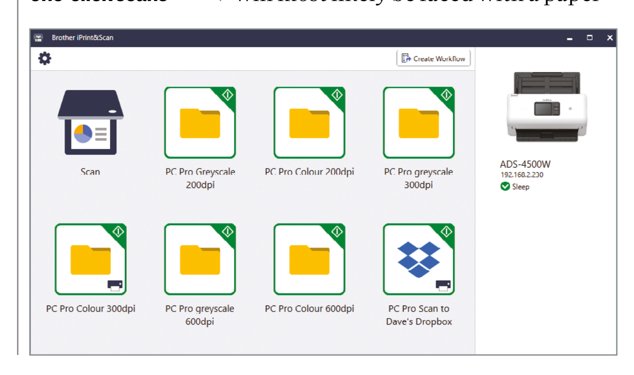
> **"Digital records are more secure and can be easily backed up and restored, and you can have a positive impact on the environment"**

Businesses that want total control over their document management processes should consider a standalone network scanner. These add extra levels of security as they can be remotely configured to present authorised users with a range of scan jobs on their touchscreens that send documents automatically to predefined destinations such as network file shares, servers and cloud storage.

Digital love

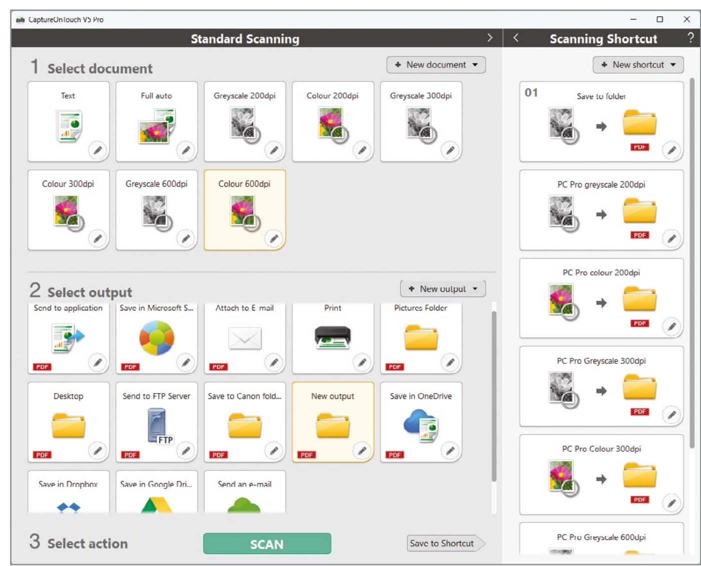
SMBs starting their digital journey will most likely be faced with a paper

BELOW Brother's iPrint&Scan app lets you create workflows for fast one-click scans









mountain so will need a fast scanner to clear it as quickly as possible. This isn't as expensive as you might think: the four scanners in our guide cost between £195 and £766 and offer speeds ranging from 20 pages per minute (ppm) up to a scorching 65ppm.

You should also look at future requirements, since once your digital office is running smoothly you'll almost certainly find more paperwork that can be scanned in on a regular basis. It's better to go for more speed than you need now to maximise your investment over the long term.

If you're regularly dealing with stacks of documents, you'll want a scanner with an automatic document feeder (ADF) so it will be able to churn through them without you having to feed each page in manually. Check the scanner's maximum daily duty cycle, too, as you'll want one that can keep up with you and not break down through overuse.

Duplexing is another essential feature, which allows documents to be scanned on both sides in a single pass. Many organisations send paper documents printed on both sides of a page to reduce costs and environmental impact, so you won't want your staff wasting time flipping pages over to be scanned.

Paper sizes are also important. For most businesses, support for A4 and Legal will be sufficient. Bear in mind that A3 scanners are expensive, but you can avoid them by looking for a "folio mode" feature that scans both sides of a folded A3 sheet and digitally stitches the two images together.

We need a resolution

Scanning to a digital vault requires a fully managed storage system, as this can grow hugely in size over time and will need to be integrated into your backup system to ensure it is protected. Furthermore, choosing the right scan resolution can make substantial storage savings.

All good scanners can produce perfectly legible digital copies at 200 dots per inch (dpi), but you may want the option to step up to 300dpi for improved quality. Anything higher is unnecessary for most business documents; 600dpi increases file sizes significantly and can hit scan speeds hard.

The management software supplied with scanners supports a wide range of output formats, including JPEG, BMP, PDF and searchable PDF (sPDF). The latter is a great choice for archiving documents as you can quickly search through their contents for specific details such as dates, payment amounts, company names and so on.

They will take up more storage space than other formats but, for general business use, a 200dpi greyscale output is fine for quality and space-efficient sPDFs. Play around with them to see which works best and then standardise it so every employee uses the same settings.

TOP LEFT Xerox's AI app keeps all your documents neatly organised

ABOVE Canon's CaptureOnTouch software links document and output profiles

BELOW Epson's ES-C320W offers U-turn and straight paper paths

Epson Installer [ES-C320W]
Placing Originals
License Agreement
Select Options
Setup
Installation
Check Functions
Finish
This product uses two different positions for scanning, depending on the document being scanned.
See the User's Guide for more details on scanning and available originals.

Scanner Position	Available Originals
Vertical Path Position	~A4, Receipt, Postcard, Business Card
Straight Path Position	B4 ~ A3, Long Paper, Card, Passport, Booklet, Envelope

Click Next.
Skip Back Next

Destination anywhere

The software provided with business-class scanners allows you to specify where you want your scans to be sent, with typical destinations including local or networked folders and FTP or SharePoint servers. Ensure that your users are all on the same page for destinations, otherwise your digital documents will be difficult to locate and manage if they're scattered across multiple systems and locations.

The cloud is another option, providing a ready-made central repository for storing documents. Cloud support varies considerably across scanner vendors, with the best ones providing facilities for sending scanned documents directly to cloud accounts such as OneDrive, Dropbox and Google Drive.

If you're already using a cloud file-sharing service there's no reason not to integrate document-scanning workflows into it. Cloud providers offer secure facilities for restricting access to specific users, and you have the added bonus of off-site storage so digital documents can be accessed by staff anywhere and from any device.



Brother ADS-4500W

Limited cloud support, but this network desktop scanner delivers great quality and speed at an affordable price

SCORE ★★★★☆

PRICE £295 exc VAT
from printerbase.co.uk

Brother's extended family of desktop scanners offers SMBs plenty of options so they can find the right balance of scan speeds, features and value. The ADS-4500W represents the centre ground and delivers a lot for its modest sub-£300 price tag, with a top claimed scan speed of 35ppm, a good 5,250-page daily duty cycle and a capacious 60-page automatic document feeder.

Connection choices abound, with the ADS-4500W supporting USB, 10/100 wired Ethernet and 2.4GHz 802.11n wireless access. It comes with a generous software bundle that includes Brother's iPrint&Scan and ScanEssentials scan management apps, Nuance's Paperport 14 SE digital file cabinet, Kofax's Power PDF 3 OCR and document conversion tool, and the Presto Image Folio graphic and photo-editing utility.

There are two notable compromises: the scanner's 7.1cm LCD colour touchscreen is smaller than Brother's two higher-end models and has fewer scan destination options. The ADS-4500W doesn't support Brother's Web Connect portal, either, so you can't scan directly from the touchscreen to cloud apps such as SharePoint Online, Dropbox and OneDrive.

Installation on our Windows 11 test clients was swift. Brother's downloadable setup utility loads all drivers, the iPrint&Scan app and a firmware update tool that can be set to regularly check for new versions. It also adds Brother's Utilities app, which you use to download and install the Nuance, Kofax and Presto software.

Network scans of a 40-page sheaf of bank statements showed the ADS-4500W is quite capable of achieving its quoted top speed at 200dpi and 300dpi resolutions for both greyscale and colour. Speed dropped to 10.5ppm at 600dpi, but you won't need such a high resolution for document archiving since greyscale quality at 200dpi is easily good enough.

When creating searchable PDFs (sPDFs), the software's OCR capabilities correctly converted every word on our statements down to small 6pt fonts. Paper handling is another winner, with the scanner handling all our bank statements, till receipts, courier waybills and registration forms without a single jam occurring.

ABOVE **Brother's ADS-4500W offers lots of features at a reasonable price**

PC PRO RECOMMENDED

The iPrint&Scan app streamlines desktop scanning by using one-touch workflows to define local, email or other applications as destinations and apply settings such as resolution, blank page skipping and a choice of eight output file formats.

It makes up for the lack of integral cloud scanning as it supports Dropbox, OneDrive and Google Drive accounts as destinations, and you can register selected workflows with the scanner so they appear in its touchscreen menu listed under the host's name for easy selection.

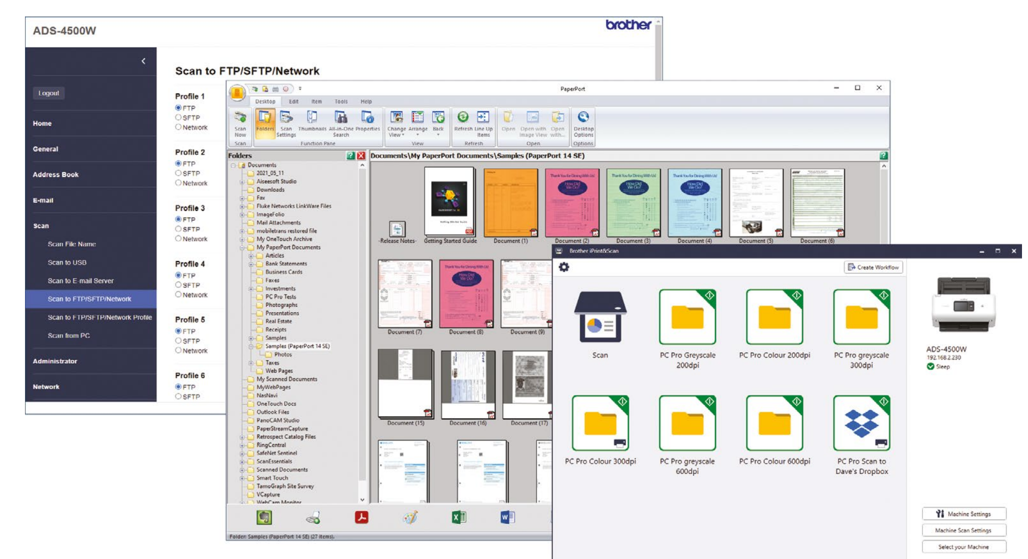
This app is the preferred choice if you have networked Brother printers and MFPs as well but, if not, you can use the dedicated ScanEssentials app which provides all the same quick scan workflow features.

> **"The ADS-4500W is quite capable of achieving its quoted top speed at 200dpi and 300dpi resolutions for both greyscale and colour"**

Mobile workers are also catered for: the Mobile Connect iOS and Android apps access the scanner over the network, pull in scans and save them locally or email them as JPEGs or PDFs.

The scanner's web console can be used to create up to 25 profiles for direct scans to FTP sites, email servers or network shares, and it provides an email address book with room for up to 300 entries. Walk-up scanning is a pleasant process: you select a profile, an email address or a networked PC with Brother's software installed and you can add multiple scan shortcuts in the touchscreen and group them under custom tabs for even quicker access.

Small businesses seeking an affordable desktop scanner will find Brother's ADS-4500W has plenty of appeal. It offers a fine set of walk-up scan features, output quality is beyond reproach and its iPrint&Scan app delivers great scan workflow management features.



BELOW **A generous bundle of scan management utilities is included**

SPECIFICATIONS

600dpi A4 colour scanner • 35ppm at 300dpi colour/mono • simplex/duplex • 60-page ADF • 7.1cm colour touchscreen • USB-A 3.2 Gen 1 • USB-A 2 host • 10/100 Ethernet • Wi-Fi 4 • Wi-Fi Direct • max. daily duty cycle 5,250 pages • external PSU • Brother ScanEssentials and iPrint&Scan, Nuance PaperPort, Kofax Power PDF Standard 3, Presto ImageFolio 4.5 software • 300 x 216 x 191mm (WDH, closed) • 2.7kg • 1yr RTB warranty



Canon imageFormula DR-M140II

A tad pricey, but this compact USB scanner can handle a high demand and delivers good speeds and quality

SCORE ★★★★☆

PRICE £525 exc VAT from ballicom.co.uk



ABOVE Canon's imageFormula DR-M140II is a compact workhorse

Canon's imageFormula DR-M140II could be the perfect fit for small businesses with equally small spaces. This low-profile desktop scanner is a standalone USB-only device with no network capabilities but it teams up a good 40ppm speed and duplex single-pass scanning with a mighty 8,500-page maximum daily duty cycle.

Its small stature means it will easily fit underneath a reception desk, and it uses a U-turn paper path where documents are placed in the front 80-page feeder and deposited in an upper tray with a flip-up paper support. This mode can handle paper weights up to 128g, but for bulkier documents and business cards up to 255g you can drop the rear flap down to create a straight-through path.

A big advantage of USB scanners is their simple installation process. For the DR-M140II, we chose a Windows 11 host PC, downloaded and ran Canon's setup utility, left it to install the TWAIN drivers plus Canon's CaptureOnTouch 5 Pro scan management software and then simply plugged the scanner in.

The CaptureOnTouch software streamlines scan operations, with document profiles used to gather together settings for colour or mono scans, as well as the resolution and tools for blank page skipping and image rotation. This is the Pro version so you also get batch separation controls using functions such as page counts, barcodes and zonal OCR.

You have eight output file formats to choose from and OCR is applied automatically when the PDF option is selected. If you don't want this, just deselect the "Add OCR information" tickbox in the PDF settings window.

Along with the OCR profile plugin, the install process adds others for saving scans to local or network folders, user-defined apps, printers and FTP or SharePoint servers. You should also check out Canon's support site, which provides extra free plugins for sending scans to local Dropbox, OneDrive and Google Drive sync folders for cloud uploads.

A plugin is included for emailing scans, which automatically loads the host's local email client for you to provide a recipient and subject. Add the free SMTP plugin and, after entering your mail server details, you can email scans directly from the CaptureOnTouch interface.

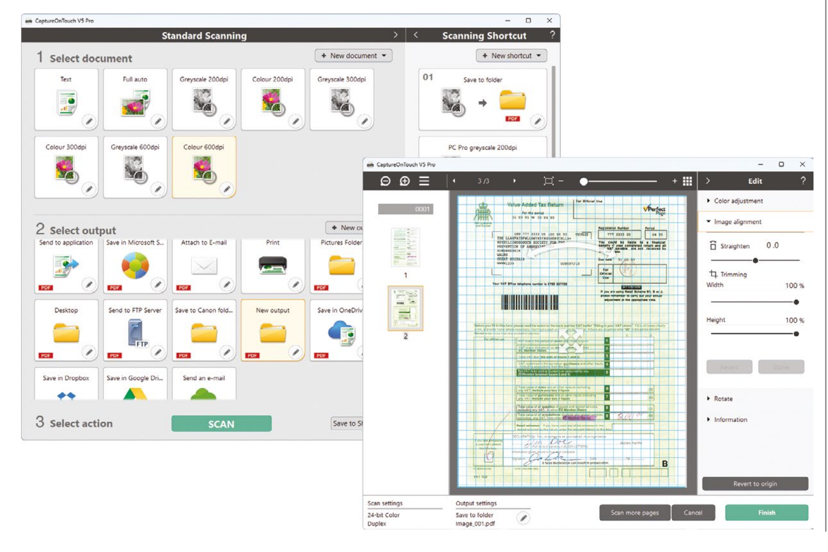
As the scanner uses standard ISIS/TWAIN drivers, you can acquire scans from any other compliant third-party app. Prior to scanning, the driver loads a user interface where you can tweak the image processing controls, set a resolution and save the image in whichever format the app supports.

For on-demand scans using CaptureOnTouch, you highlight a document and an output profile and tap the scan button below. The other option is to create shortcuts in the right-hand pane to link document and output profiles and publish up to nine on the scanner's single-digit LED panel for quick walk-up access, though you'll need to put a list next to it to explain what each number does.

> **"The CaptureOnTouch software streamlines scan operations, with document profiles used to gather together settings"**

Performance is on the money, with duplex greyscale and colour scans of a 40-page sheaf of bank statements delivering precisely 40ppm at both 200dpi and 300dpi resolutions. Moving up to 600dpi saw greyscale and colour scans returning 17.4ppm and 10ppm, but there's no need to use the maximum resolution for general archival purposes as we found 200dpi produces perfectly acceptable searchable PDFs. The scanner handled all our various test documents without any jams.

For a 40ppm USB desktop scanner, Canon's imageFormula DR-M140II isn't the best value but its compact dimensions make it a great choice for SMBs with limited desk space. It delivers good scan speeds, output quality is impeccable and the CaptureOnTouch software makes light work of all scan operations.



LEFT The software offers a range of scan management features

SPECIFICATIONS

600dpi A4 colour scanner • 40ppm at 300dpi mono/colour • simplex/duplex • 80-page ADF • USB-A 2 • max. daily duty cycle 8,500 pages • external PSU • ISIS/TWAIN drivers • Canon CaptureOnTouch 5 Pro software • 313 x 181 x 93mm (WDH, closed) • 2.6kg • 1yr standard hardware warranty



Epson WorkForce ES-C320W

A space-saving wireless desktop scanner that combines good scan speeds and quality with superb value

SCORE ★★★★☆

PRICE £180 exc VAT
from printerland.co.uk



ABOVE The Epson ES-C320W stands almost vertically to save on space



Epson's WorkForce ES-C320W is aimed at small businesses that demand convenience over capacity. As a member of Epson's family of ultra-compact U-turn desktop scanners, it requires minimal desktop space as it doesn't need a front paper output tray.

In U-turn mode, the scanner sits almost vertically with documents placed in the rear 20-page automatic document feeder (ADF) and ejected into a front stacker. For bulkier documents up to 5mm thick, you pull the release lever out from the side and the body leans back so they pass out of the front slot.

Costing less than £200, the ES-C320W is great value. It offers USB 2 and 2.4GHz 11n wireless connection options and claims a speedy 30ppm for colour scans at 300dpi. Unlike the higher-end ES-C380W it doesn't have a colour LCD operator panel so it can't operate in Epson's "ScanWay" standalone mode, but all the supplied software utilities support network access for remote scanning.

Deployment on a Windows 11 host PC was swift, with a single utility handling the driver download and installation of Epson's Scan 2 and ScanSmart utilities, a software updater tool and Presto BizCard 6. It deftly handles network configuration as you connect the scanner to the host over USB, choose the wireless network you want to link it to and remove the USB cable when instructed.

On completion, the utility runs a test scan to confirm all is well and then runs a firmware upgrade. Subsequent installations on other PCs won't take long because they auto-discover the scanner on the network and load all the utilities preconfigured and ready for use.

Be careful if you have multiple PCs accessing the scanner as only one can be paired with it at a time. The scanner has a one-touch button on its front panel for walk-up scans, and to avoid the document going to the wrong recipient you first need to claim it from the ScanSmart settings page.

Epson's Scan 2 utility is loaded when tweaking settings from ScanSmart or acquiring scans from third-party apps using the TWAIN driver. It provides plenty of scan controls: you can select a resolution, colour, greyscale or mono output, simplex or duplex operations, correct skew and skip blank pages.

The ScanSmart app offers options to start duplex or simplex scans and presents a preview window for manipulating the images and then selecting an action. There are plenty available, too; scans can be saved to local or networked folders, printed, attached to an email using the local mail app, converted to Word, Excel or PowerPoint formats, or sent directly to Google Drive, Dropbox, Evernote and OneDrive.

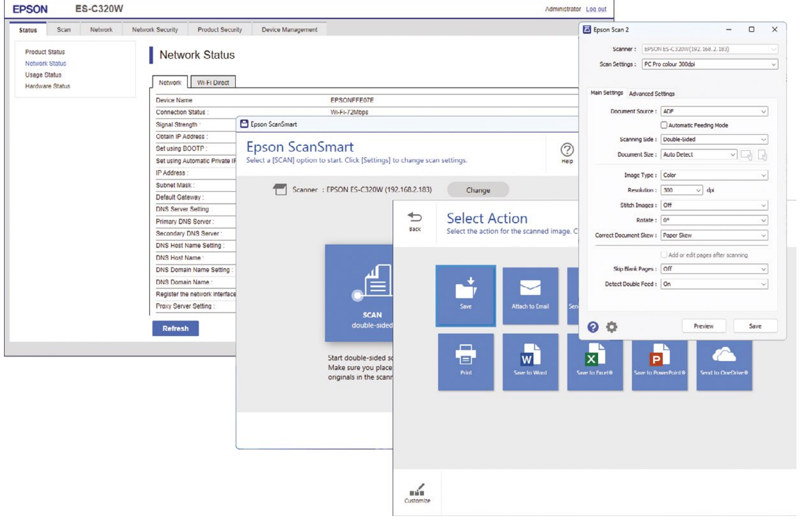
Output file formats include PDF, sPDF, JPEG, BMP, TIFF and PNG. Cloud destinations require a one-time login, after which you choose a cloud folder, provide a filename and optionally save a local copy.

The ES-C320W can handle passports, which are best placed in Epson's optional carrier sheets to avoid potential damage. Note also that, unlike the Document Capture Pro software included with Epson's DS-C490 model, ScanSmart can't process machine readable zones on passports.

> **"If you don't need standalone scanning operations, the ES-C320W is a much cheaper alternative to Epson's ES-C380W"**

The ES-C320W had no problems delivering the quoted speeds in our tests, with duplex greyscale and colour scans of 20 bank statements averaging 31ppm at both 200dpi and 300dpi resolutions. Colour scans at 600dpi drop to a pedestrian 5ppm, but you won't need this for general document archiving as 200dpi delivers perfectly acceptable results.

If you don't need standalone scanning operations, the ES-C320W is a much cheaper alternative to Epson's ES-C380W. It delivers the same nippy speeds and requires an equally small amount of desk space, and Epson's software offers plenty of scan management features.



LEFT The scanner has a web interface and comes with a good range of scan management tools

SPECIFICATIONS

600dpi A4 colour scanner • 30ppm at 300dpi colour/mono • simplex/duplex • 20-page ADF • Wi-Fi 4 • Wi-Fi Direct • USB-A 2 • rec. daily duty cycle 3,500 pages • external PSU • Epson Scan 2, ScanSmart and Presto BizCard 6 software • 296 x 104 x 125mm (WDH, closed) • 1.8kg • 1yr RTB warranty



Xerox N60w Pro Scanner

Walk-up scanning couldn't be easier, making the N60w Pro perfect for businesses with a need for speed

SCORE ★★★★★

PRICE £766 exc VAT from tradescanners.com

Businesses with heavy scan demands that don't want the added expense of a host PC will find the Xerox N60w Pro Scanner is almost certainly the answer. This wired and wireless networked scanner delivers everything you need for easy walk-up scanning and claims a fast 65ppm scan speed.

The N60w Pro presents a generous 20.3cm colour touchscreen that can be customised with multiple soft buttons for quick access to scan jobs. Users simply load their documents in the large 100-page automatic document feeder, tap a job button and Xerox does the rest.

The touchscreen makes light work of scan operations, with icons in its left pane for sending documents directly to the cloud, email, network shares, FTP and SharePoint servers or the scanner's public folder. Users enter the relevant details on the screen when they start a scan, but this can be streamlined by using the scanner's touchscreen or web interface to create profiles and shortcuts.

We tested this by adding details of our SMTP mail server and creating an address book with multiple email addresses. You can do the same for file destinations such as SMB shares and FTP locations, and these profiles can be selected from the screen when starting a scan.

Cloud scanning supports Google Drive, OneDrive, Evernote and SharePoint Online. Presumably for security reasons, cloud login details can't be added to shortcuts so users will need to enter these at the touchscreen's sign-in page for every scan job, and they're always sent to the account's root folder.

For scanning from PCs, the installation routine loads the Windows drivers plus Visioneer's OneTouch scan management app, Organiser AI for smart document management, Capture SE for batch scans and DriverPlus for scan customisation. You can also install the full versions of ABBY's FineReader OCR and PDF 15 scan tools.

There's nothing more to be done if the scanner is tethered to the PC over USB, but if you want network scanning you'll need to install the Network Scanner Manager app. This allows you to connect to the scanner's IP address and use OneTouch, TWAIN or WIA.

OneTouch links a menu of nine function settings to a range of actions, including scans to host applications, local and network folders, printers, email, fax, FTP and SharePoint servers, while output formats include BMP, JPEG, TIFF, PDF and sPDF. The OneTouch Acuity feature provides anti-skew, auto-crop, de-speckling, page rotation and blank page skipping while its redaction feature obscures custom areas of a scan with coloured blocks.

The N60w Pro went beyond the call of duty in our performance tests, with its duplex scans of 40 bank statements returning 66.7ppm at all resolutions. Even adding OneTouch's LAN acquisition time of six seconds still equated to speeds of 57ppm. The shallow paper path handled all our documents with ease, and we found output quality at 200dpi quite sufficient for archiving purposes.

For remote cloud access, the scanner must be registered with Visioneer's free VAST cloud portal, which supports Google and Microsoft account logins. You can then use the Network Scanner Manager to log in to your account, remotely connect to the scanner and carry on as normal.

A smart feature is the OneTouch icon on the touchscreen. This provides a direct link to local and remotely connected PCs. Select one from the list and it will present the nine OneTouch function buttons for that machine so you can push scans to it.

For a standalone scanner the N60w Pro is excellent value, and its extreme versatility adds extra appeal. It delivers great speed and output quality, offers a plethora of connection options and makes walk-up scanning a breeze.

ABOVE The Xerox N60w Pro's colour touchscreen makes scanning a breeze



"The N60w Pro presents a generous 20.3cm colour touchscreen that can be customised with multiple soft buttons"

SPECIFICATIONS

600dpi A4 colour scanner • 65ppm at 300dpi mono • simplex/duplex • 100-page ADF • 20.3cm colour LCD screen • USB-A 3.2 Gen 1 • 1GbE port • Wi-Fi 4 • rec, daily duty cycle 10,000 pages • external PSU • Visioneer OneTouch, Acuity, Capture SE, Organiser AI, DriverPlus, ABBYY FineReader OCR and PDF 15 software • 316 x 207 x 178mm (WDH, closed) • 4.7kg • 1yr advanced exchange warranty



LEFT Xerox offers plenty of scan and document management tools



Netgear MS108TUP

A feature-rich multi-gigabit switch with plenty of PoE services and smart cloud management capabilities

SCORE ★★★★☆

PRICE £357 exc VAT from broadbandbuyer.com

Netgear has one of the largest portfolios of network switches on the planet, and its MS108TUP targets SMBs seeking a versatile, low-cost Power over Ethernet (PoE) solution. Aimed at applications such as VoIP, surveillance and high-performance wireless deployments, this pocket-sized switch offers eight 2.5GbE multi-gigabit ports, with the first four delivering 60W PoE++ services and the remainder providing 30W PoE+.

The switch uses its chassis as a heatsink, and the fanless design means it's completely silent. The device may be small, but its 230W power budget is very big and it's delivered by a hefty 253W external power supply that's around half the size of the switch.

The MS108TUP looks identical to Netgear's slightly cheaper MS108EUP but offers a lot more features. They have the same power budget but, as a member of Netgear's smart switch family, the MS108TUP supports standalone and Insight cloud management, provides L2 switching plus Lite L3 static routing services, includes PoE self-healing that automatically reboots powered devices if they become unresponsive and has an uninterrupted PoE feature, which ensures that devices remain powered during firmware upgrades and soft reboots.

Deployment in standalone mode is swift, with the browser wizard simply asking you to change the default admin password. The web interface dashboard presents a detailed overview of the switch showing available and used ports, a VLAN membership pie chart and a coloured graphic below for each individual port, with a bar showing total power consumption.

Along with power schedules, you can set one of four power priorities on each port so if the power draw gets close to the maximum available the switch will turn off those with the lowest priority first. The 230W power budget should cover most usage scenarios, though, as after connecting Netgear's WAX620 and WAX625 Wi-Fi 6 access points, its tri-band WAX630E Wi-Fi 6E AP and a Zyxel WBE660S Wi-Fi 7 model, we could see the web console reporting a total draw of 42W, leaving a generous 188W up for grabs.

Click on any port in the dashboard and a pop-up menu provides quick access to its settings and statistics along with options to run a cable test, configure VLAN membership and set access controls and port security.

VLAN support is outstanding; the switch can automatically recognise devices using a customisable organisationally unique identifier (OUI) table and dynamically create separate VLANs with traffic prioritisation for VoIP phones, wireless APs and IP cameras.

ABOVE The MS108TUP is a completely silent, pocket-sized switch



LEFT There are eight 2.5GbE multi-gigabit ports, four of which deliver 60W PoE++

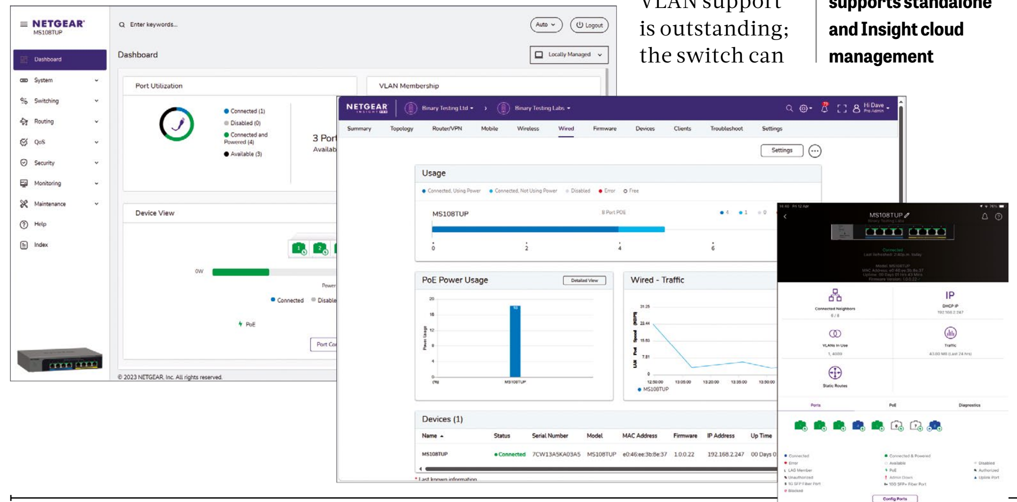
The price includes a one-year Premium subscription to Netgear's Insight cloud portal, with subsequent years costing around £8.95 per device. Cloud deployment is easy: you can swap to your Insight account directly from the standalone web console, add the switch in the portal using its serial number or scan its QR code from the Insight mobile app.

We used the latter method from an iPad and, after assigning the switch to a predefined site in our Insight organisation, its local web console was disabled and it received a firmware upgrade. Moving the switch to Insight set it back to factory defaults, but it was simple enough to reconfigure as all wired network and switch device settings are easily accessible from the portal.

"The device may be small, but its 230W power budget is very big and it's delivered by a hefty 253W external power supply"

The Insight dashboard provides a great overview of your network plus all associated devices, and its widgets can be customised and dragged around the page to suit. For the switch, Insight offers widgets for PoE usage as a percent of its budget, used and free ports and wired data consumption for each active port.

The MS108TUP isn't as good value as Zyxel's XMG1915-10EP (*see issue 356, p103*), which offers PoE++ services on all eight 2.5GbE ports, adds dual 10GbE SFP+ fibre uplinks and costs over £100 less. That said, the MS108TUP is the superior choice for servicing power hungry PDs such as PTZ IP cameras as its budget is nearly twice as large, it offers a great range of features and is a natural choice for Netgear-centric businesses. **DAVE MITCHELL**



BELOW The switch supports standalone and Insight cloud management

SPECIFICATIONS

Desktop fanless chassis • 8 x 2.5GbE (4 x PoE++, 4 x PoE+) ports • 230W power budget • 40Gbits/sec backplane capacity • 1.5MB packet buffer • 16K MAC addresses • 253W external PSU • 210 x 140 x 40mm (WDH) • 900g • web browser and Insight management • limited lifetime warranty



TP-Link Omada EAP683 LR

A business Wi-Fi 6 access point with good speeds and increased range plus great cloud management services

SCORE ★★★★☆

PRICE £162 exc VAT
from broadbandbuyer.com

TP-Link's dual-band EAP683 LR offers SMBs an affordable dual-band Wi-Fi 6 solution with an extra reach. An AX6000 rating makes this currently the fastest of TP-Link's Wi-Fi 6 APs, with claimed speeds of up to 1,148Mbits/sec on the 2.4GHz radio and 4,804Mbits/sec on the 5GHz radio, which supports high-speed Wi-Fi-6 160MHz channels.

The EAP683 LR has four internal aerials for each radio and boasts a maximum coverage of 185m² – a 32% increase over the cheaper EAP670 (*see issue 341, p96*). TP-Link doesn't provide any enlightenment on the reasons for this extra spread, but we can see from the datasheets that the EAP683 LR has a higher transmission power rating on its 5GHz band.

It's also one of TP-Link's new range of slimmed down APs, as this 220mm diameter discus is only 32.5mm in depth and tips the scales at a ceiling-friendly 695g. It provides a 2.5GbE multi-gigabit port and requires a basic 802.3at PoE+ power source or TP-Link's optional 12V adapter.

Deploy the EAP683 LR in standalone mode and its web console quick-start wizard requires you to supply a new username and password, after which it removes the default admin account for extra security. Up to eight SSIDs per radio can be created, and the wizard asks you to configure the first two and provide new encryption keys.

The EAP683 LR delivered good speeds in our Wi-Fi 6 performance tests, where we used a Dell Windows 11 Pro workstation equipped with a TP-Link Archer TXE75E Wi-Fi 6/6E PCI-E adapter. With the 160MHz channels enabled, large file copies between the workstation and a Windows server on our 10GbE LAN averaged 194MB/sec, dropping to 183MB/sec with the AP placed ten metres away in an adjoining room.

We also tested mobile wireless coverage using an iPad running the Wi-Fi Sweetspots iOS app. With a 5GHz 80MHz connection, we recorded 67MB/sec at five metres, and moving 15 metres away into another room with a brick wall in the way saw a small drop to 62MB/sec.

Remote management options are extensive. You can install TP-Link's hardware or free software controller on-site or use its cloud-based controller, which has a yearly fee of £165 for 250 devices. We took the hardware route and teamed up TP-Link's OC300 controller appliance with its TL-R605 broadband router and TL-SG3210XHP-M2 eight-port 2.5GbE PoE+ multi-gigabit switch.

The Omada cloud portal simplifies site management as it presents a list of all controllers assigned to your account. Selecting the OC300 took us to its own portal, which presented a customisable dashboard and a ribbon across the top showing internet capacity, gateway usage, switches, APs, clients and guests.

Adding the EAP683 LR was simple as it appeared as "pending" and, once adopted, it took all its settings from the controller and broadcast our predefined site SSIDs. The same number of SSIDs in standalone mode are supported by Omada and you can apply mixed mode WPA2/WPA3 encryption, rate limits, load balancing and SSID schedules to determine when they are active.

Wireless coverage can be increased even further as the EAP683 LR supports meshing. A wired AP functions as a mesh root, other compliant Omada APs connect to it over a 5GHz backhaul, and up to three hops between them and the root AP are permitted.

Any SSID can be set as a guest network where L2 isolation is automatically applied so clients receive internet access but can't see private IP addresses on the LAN. Captive guest portals can also be assigned to SSIDs by creating profiles using a range of authentication methods and options to present custom portal pages with your own choice of colours, logos and messages, such as the terms of service.

The EAP683 LR is a reasonably priced Wi-Fi 6 business AP that offers modest but measurable improvements to wireless coverage. It delivers respectable performance and plenty of business-class features, while TP-Link's Omada cloud portal makes light work of remote management. **DAVE MITCHELL**

ABOVE The dual-band EAP683 LR is the fastest of TP-Link's Wi-Fi 6 APs



"The EAP683 LR has four internal aerials for each radio and boasts a maximum coverage of 185m²"

LEFT The diminutive AP provides a 2.5GbE multi-gigabit port

BELOW TP-Link's Omada service provides smart cloud management

SPECIFICATIONS

AX6000 dual-band 2.4GHz/5GHz 802.11ax • 4 x 2.4GHz/4 x 5GHz internal aerials • 2.5GbE LAN/802.3at PoE+ • ceiling/wall mount kit • 220 x 220 x 32.5mm (WDH) • 695g • DC power adapter not included • standalone or Omada cloud management • limited lifetime warranty

What ChatGPT can do for your business

From summarising documents to training and code development, ChatGPT's capabilities can benefit almost any business. Steve Cassidy explores the AI platform's potential

Few technologies in the past few decades have created as much excitement as ChatGPT. The idea of an ethereal electronic brain that can synthesise the world's online knowledge and information to create something new and perfectly adapted to your purpose seems like the stuff of magical science fiction.

This image inspires unrealistic aspirations and expectations. A friend of mine posted on social media that he was looking forward to trying ChatGPT on a multi-million-pound commercial property valuation, prompting a lengthy thread about the pros and cons of generative AI. To be fair, his experiments produced plausible documents. But every time he ran the request it generated a different plausible document. Normally a commercial property offer is the settled conclusion of lots of time spent trudging round a physical location and kicking at brickwork. Can an automatically generated document, built on inferences and linguistic probabilities, replace that? Even if he gets away with it in the short term, it's a recipe for future horror stories.

So the question arises: what can your business safely use ChatGPT for? It's not a question with a single easy answer, as the core invention – the large language model – opens up a bag of different utility modes. Rather than thinking of ChatGPT as a single service, it's better to approach it as a low-level library of text-based AI routines that can speed up all sorts of tasks.

Forwards and backwards

One of the beguiling things about ChatGPT is how easy it is to use. You simply give it a format, a subject and a desired output style; it then delves into its enormous database of digested verbiage and produces with something that at least superficially resembles a high-quality answer.

The sources that ChatGPT draws on are broad and varied, including news websites, online forums, scholarly articles and works of fiction. In fact, there are several lawsuits under way over ChatGPT's use of copyrighted works, but for businesses AI is often most useful when it's working on your own data. ChatGPT lets you upload your own documents, to focus the AI on your specific circumstances or line of business – although the more the algorithm relies on the documents you've supplied it with, the less likely it is to find fresh, unexpected angles.

When using ChatGPT, it helps to consider the difference between "forward" and "backward" queries. The former is when you don't know something and want the AI to fill in the blanks, in questions such as "how can our business improve customer

retention?" or "what's the best way to reduce manufacturing costs?". Backward queries are more about focus and selectivity: feed in a mass of text or numbers, and get summaries and keywords out.

Summarising is, in fact, a great use for ChatGPT. As long as you've set up your query correctly and uploaded the right documents into the AI, not a lot can go wrong. The process isn't quite as instantaneous as evangelists might suggest, as you need to learn how to address and feed the system to get good results, and you still need to go through the output to check the algorithm hasn't messed up. Even so, this is an area where AI can provide a real advantage, as the draft is generated in seconds, rather than taking a human a morning to pull together.

The old school chatbot

While ChatGPT is a rapidly evolving technology, its mode of operation is basically the same as classic interactive chat systems dating back to the 1960s. That means it's perfectly suited to running chatbot services on company websites and the like, and this is fully supported by its operator. I hardly need spell out the appeal of a digital concierge that allows customers to ask questions and make requests in natural language, and get plain English responses in reply.

Before you leap in, though, it's worth seriously considering whether having a chat-based service presented on your website is really a win for you. In a world that's already fully familiar with Alexa, Siri and other voice-based AIs, the idea of having to type into a text-input box feels oddly retro.

And remember, the AI is only a front end: right now I'd say most business chatbots are operating as receptionists rather than sales reps or technical support agents. For ChatGPT to really enhance the customer experience, the underlying systems – the customer database server, transaction history, outstanding alerts and so forth – all need to be tightly coupled to the chatbot.

I'm not saying this can't be done, but it's not simply a question of embedding a widget in your website and sitting back. It's an investment, the scale of which depends on how easily your workflows can be navigated by a conversational AI, or re-engineered to suit. Some industries can adopt AI with very little hassle, whereas for others it's a big enough job that it makes more sense to sit out the current generation of chatbot technology.



ABOVE Chatbots can feel retro in these days of Alexa, Siri and Google Assistant

The opposite of a summary

In a presentation some years ago I heard from no less an authority than Dell that – according to the company's own research – 90% of documents stored on a business server were, once uploaded, never opened again. This, Dell said, presented an opportunity for businesses to slash their reliance on expensive high-speed storage by moving less "hot" data to cheaper, slower media.

The trick is identifying what's important and what isn't – and this is an area where ChatGPT's capabilities can be invaluable. Point it at a folder full of old documents and emails and it can instantly pull out the key conclusions and data points. Having extracted these insights you can then archive the source documents on low-cost NAS or Blu-ray resources.

"Before you leap in, it's worth considering whether having a chat-based service on your website is really a win for you"



LEFT Simply embedding ChatGPT into your website is not enough

Strengths and rivals

It's remarkable how a single product can occupy the collective mind of the IT industry – and its customers – for years. A while ago it was Alexa; a little before that we were all chafing at the limitations of Google Glass. Obviously I don't need to tell you what the current obsession is.

But the discourse over ChatGPT isn't entirely new. We've been through a lot of these discussions before with Alexa, which has become both a portal for customers into businesses and an aid for workers inside them. Like ChatGPT, it involves lots of processing power hidden in the cloud, deciphering what you're saying and throwing back a plausible answer, in the form of natural language rather than a digital array or a statistical table. Amazon offers tools and advice for businesses wanting to integrate with Alexa at **tinyurl.com/358alexa**.

Another aspect of ChatGPT's job is mirrored by Wolfram Alpha (**wolframalpha.com**), the supercharged search utility that attempts, with astonishing success, to interpret queries in terms of maths and statistics,. Both Alexa and Alpha have strong followings in niche business sectors, with Wolfram scoring heavily on mathematical and even equation-based tasks.

Don't forget traditional web-search portals, either. While ChatGPT knows a lot of information, both Google and Microsoft Bing are also using AI to provide direct factual responses to queries – and when you can see the websites and resources that such responses are based on, you're less likely to be tripped up by "hallucinations".

Where ChatGPT really distinguishes itself is in its ability to generate computer code. This has come as something of a surprise to many, not least developer OpenAI, which didn't design it for this purpose. But it makes sense: the data set on which it's based includes millions, perhaps billions, of programs and scripts, most of which are generally well formed and functional. So it makes sense that the AI would know how to produce working code, and have some sense of what operations were appropriate to what contexts.

As with generating training materials (*see above*), this is an area where the use of AI can be kept low-key – no-one needs to know exactly how or to what extent you're exploiting AI-generated code to speed up and simplify development. However, the responsible human element is then more important than ever, as someone needs to verify that the requested code does indeed do what it's supposed to, rather than something subtly different, in a way that's stable and secure.

→



I confess, I don't love the idea of relying on machine-extracted summaries for real-world projects. But if you're drowning in documentation, AI is more likely to pick up correlations and outliers than a human trawling through hundreds of documents by hand. And the time savings may offset the cost of dealing with any iffy AI inferences: the come-along page for ChatGPT Enterprise (the paid-for, more private version of the public cloud service) suggests that the corporate AI product can save researchers hours every working day – although, as is typical of the AI industry, no specific claims or studies are presented.

And let's go back to the idea that 90% of the documentation generated by a business is, after its immediate generation, never referred to again. While much of that paperwork is doubtless unnecessary, you have to wonder how much of it is ever properly absorbed in the first place. After all, humans simply don't have the time or the mental capacity to process the quantities of information available to them. If ChatGPT can search the historical archive in seconds and flag up past data and discussions, perhaps overlooked at the time, that are relevant to the matters at hand, how much better could our decisions be?

Training and presenting

ChatGPT is best known for its live chat and document-generation capabilities. But it can also do something sort of half-way between the two, producing documents with a shallow level of interactivity.

I don't mean that as a disparaging assessment: "shallow interaction" covers every PowerPoint deck I've ever suffered, with excitable marketing guys zooming through a page stack or hopscotching about in response to a leftfield question. In the modern word of computer-based training, interactivity is in the same ballpark, with exercises laid out as a series of steps or pages, requiring input from the trainee.

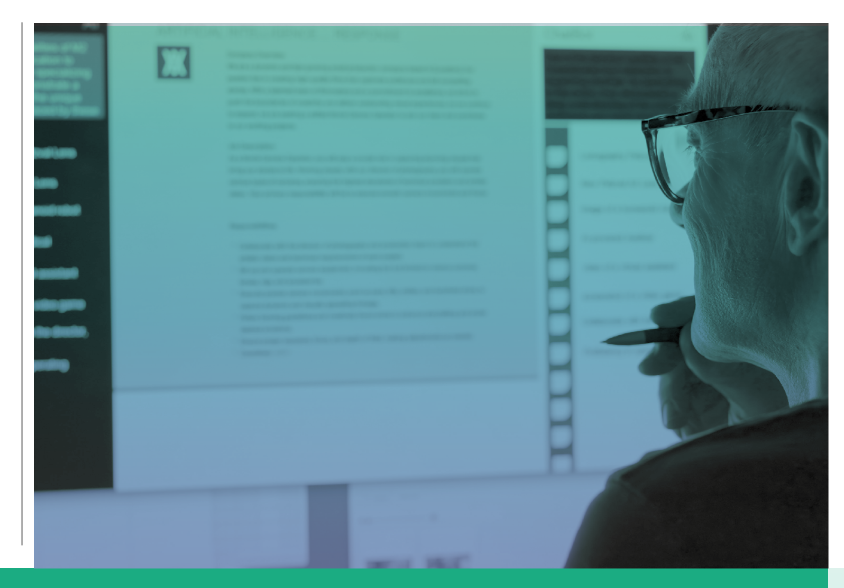
ABOVE **Some industries can adopt AI with very little hassle; for others, it may not be worth it yet**

> **"If you're drowning in documentation, AI is more likely to pick up correlations and outliers than a human"**

This type of document certainly isn't new: I first encountered such a thing while booking a boating holiday several years ago. That might sound somewhat disconnected from the world of professional computing, but the principle is much the same. Boat-hire companies need to verify that you're aware of the rules of the waterway, but of course, they want you to pass the test so they get your money. Thus, you get an online quiz with a dynamic assessment at the end, appraising your answers and setting you straight on any questions you got wrong – a classic application of computer-based training.

Although the idea sounds simple, it's remarkably hard for anyone who isn't an experienced developer to set up this sort of thing. Looking back at my own business career, I've probably wasted more time hand-crafting presentations and training materials than chatting to the office staff. And even the tools I was using wouldn't have allowed me to add a custom behaviour as part of helping candidates to pass the presented tests: I take my hat off to the boating company for its iconoclastic disregard for standard industry practice, and for its determination to put something together that didn't disqualify the ignorant in the name of safety.

ChatGPT makes it easier than ever for other companies to follow suit. The AI can either deliver the documents itself, or help by turning out some standard code that handles the dull stuff such as page transitions and button management. And because this all happens behind the scenes, you don't get the reputational exposure of entrusting your would-be customers' first interactions to an AI. The computer-generated output remains close to the "responsible human", who can use their own expertise to decide precisely what to do with it.



RIGHT **AI can quickly identify what's important and what's not in a mass of data**

How I wasn't replaced by an AI

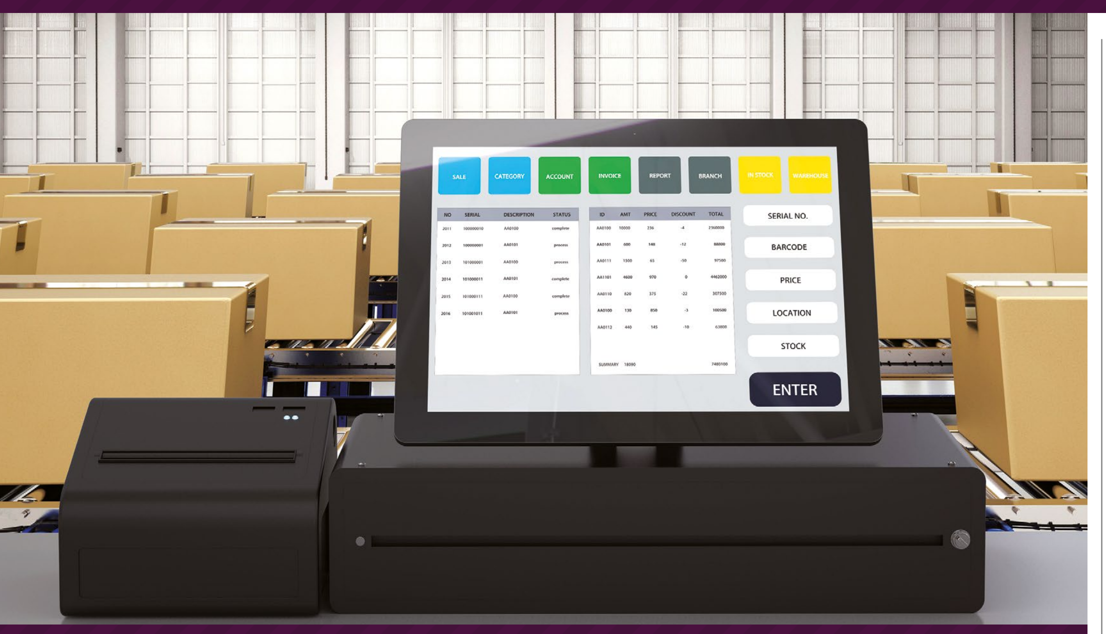
I'd not heard from one of my oldest friends in a long time, but we were recently brought together by our "third musketeer", and all reconnected over a quality cafe breakfast and some gossip.

The reunion went swimmingly – right up to the point where we each described our current projects. It turns out that our eldest member has lately reinvented himself as a bit of a pitch-maker, and for him the new world of ChatGPT has been transformational. What specifically appeals to him is its speed. Previously he would pass briefs onto professional writers, who would then take days or even weeks to produce final copy, during which time his potential investors were receiving a blizzard of other offers. With ChatGPT he can just plug in a few keywords and be sending off a pro forma pitch within minutes. For his purposes there was no debate to be had: the era of hiring human pitch-writers was over.

As something of a writer myself, I was briefly hopping mad with him. But as I thought through his enthusiastic description, I realised that he had never actually asked me to create any such documents in the first place, Clearly, ChatGPT had not reduced his call on my talents one iota. Indeed, he didn't consider it a trade-off at all. It became apparent that accuracy and professionalism, upon which his writers doubtless prided themselves – in whose name they spent those days and weeks perfecting their pitches – were, to him, almost irrelevant considerations. The crucial thing was speed.

In discussions of AI we may instinctively lament the loss of human expertise and traditional techniques, but it pays to count to ten and take a long, hard look at what people actually want the technology for. In many cases the AI is doing a job that humans could never do. It's certainly not something I'd want to be losing friends over. ●





Machine customers

Don't waste manpower on recurrent purchasing tasks, says Steve Cassidy: systems are doing it for themselves

Machine customers? I'm busy enough dealing with real customers, thank you very much.
I get the instinct, but machine customers are very real – in fact, you should probably consider setting up one of your own. Simply put, a machine customer is an autonomous service that can make purchases without human involvement. A good example is printer supplies: modern printers can monitor their own ink or toner levels, and automatically order more when supplies run low.

Well, that sounds mundane. I was picturing machines making complex purchasing decisions.
That's certainly where some futurists imagine we're heading: not just restocking the stationery cupboard but making significant decisions about which products to buy and when to switch suppliers. This, incidentally, is a bit of a nightmare for the CRM industry, whose existence largely depends on the model of human salespeople building and maintaining relationships with human customers. They're understandably terrified by the idea of dealing with advanced AIs that can't be shmoozed or bamboozled.

Okay, but that's not happening today, is it?
I doubt we'll arrive at that scenario until AI agents are much more reliable – because a dodgy buying decision could have very costly consequences. For now, machine customer setups thrive in a fairly narrow range of circumstances, and indeed are typically operated in collaboration with the vendor.

So machine ordering basically means committing to one supplier?
In effect, yes – which is why vendors love it. But it's hard to see how the technology could evolve any other way. If we lived in a world where everything ran on open standards and commodity systems then it would be relatively easy for a bot to hop back and forth between suppliers to get the best deal. But in reality most markets have their own peculiarities, and it's often not so much a case of picking between a wide field of vendors as negotiating the best overall deal from a small number of disparate options. That requires something several generations more sophisticated than a simple re-ordering system.

What's a safe way for my company to try out machine ordering?
The specifics will depend entirely on your business. If you're a sofa-making company then every so often you might need to buy lumber, woven materials and foam padding from three different suppliers. In this case you could start by setting up three machine customer jobs, tied to inventory and projected demand. There should be minimal risk, as you were going to buy these raw materials anyway, and if you're committing to regular automated orders, your suppliers may well be motivated to give you good prices.

That sounds almost too easy – what's the catch?
If you want to implement automated ordering, your ERP (enterprise resource planning) system needs to be able to talk to your suppliers' systems. This might not be as simple as it sounds; at present there are no simple self-assembly frameworks for setting up machine purchasing.

Don't give up hope, though: it's in vendors' interest to offer help and accommodations. The real problem arises when your top five vendors each use their own platforms, leaving you in the middle, needing to work with all their different payment systems, VPNs, coded emails or what have you. You have to track the value propositions in this type of built-up relationship very carefully. ●

Hidden costs

As always in IT, new ideas bring new risks. Here, the major concern isn't a new virus, but the everyday hazard of items getting damaged or lost in transit.

Because while ERP systems are clever, they operate wholly in the digital world. They can confirm that money has been paid and goods have been logged as shipped, but they can't tell you that your items have been squashed beneath an airport cargo truck or sent to a bemused grandma in New Jersey.

This means you still need humans to handle negotiations when something goes wrong. That may seem inefficient, but it's worth it when one purchase may represent a sizeable chunk of monthly turnover.

And backtracking a purchase isn't as simple as you might imagine. Bundling the purchase, payment, shipping and delivery all together into one automated transaction makes things cheaper and faster, but it requires a multi-dimensional handshake between many different entities. That complicates things when you need to untangle a failed delivery from the tens of thousands of other operations carried out that day.



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Real world computing

Expert advice from our panel of professionals

JON HONEYBALL

"Ignore anyone who says that keeping your data in a cloud storage service is enough protection. It isn't"

What would happen if you were hit by a ransomware attack today? If you don't have an immediate – and positive – answer, take heed of Jon's advice

What can you do to protect your data? Every day, along comes another nasty piece of malware, aimed at ruining your life. It could be an attack on a cloud service where you have an account; only yesterday, Bitwarden told me that someone was trying to log into my account there. Fortunately, it's protected with a hardware 2FA key.

There's a wave of ransomware going around that gets you to download some malware, often pretending to be an update. It then starts its devious work, scrambling your precious files and demanding a fee, often paid in Bitcoin, to reverse the process. Despite calls for people to not pay, it is often the only route to getting your data back if you've been attacked and had insufficient processes in place to protect yourself.

So what can you do about it? Well, the first thing to realise is that data should never be on just one device. Especially if it's a phone or laptop, which can inevitably be left on the back seat of a taxi.

When handling your data, the immediate requirement is to get a copy off the device on which it was created and onto something else. Or several other devices. Until the data has been copied over, it's vulnerable to theft, malware, hardware failure, system crash or any of the other innumerable ways in which your data is no longer available to you.

However, this isn't enough. Ignore, if necessary defriend, anyone who says that keeping your data in OneDrive, Dropbox or an equivalent cloud storage service is enough protection. It isn't. And it's obvious why this is. Let's say you get some ransomware malware onto your computer. It scrambles your files. The next thing that will happen is that the files will get replicated to the cloud store, overwriting the good files there as well. Now you have scrambled files in two locations.

There are cloud services that allow you to roll back changes, and this can certainly be a help. But there are other limitations to cloud services, too. The biggest unspoken issue is one of account management. If, for some reason, your cloud account becomes compromised – through an external attack, you didn't pay the subscription or the cloud provider simply decides to shut down your account – then you might lose access to the whole account and the files it contains.

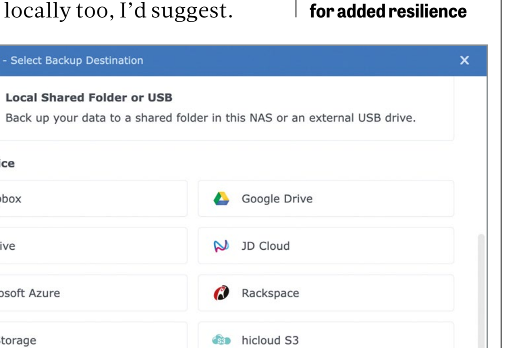
And what about Dropbox, which likes to make your storage cloud-first, only keeping a local cache of those files you've recently used? Lose the cloud account, and you don't even have a full local copy any more. Best to hit those buttons to make everything get stored locally too, I'd suggest.



Jon is the MD of an IT consultancy that specialises in testing and deploying kit
@jonhoneyball

"The first thing to realise is that data should never be on just one device"

BELOW Back up to a second cloud service for added resilience



If you lose access to your cloud service, then where are you? Cloud services such as Dropbox and OneDrive are brilliant, but I certainly don't think of them as the end point for file storage. For certain, use them as a transport layer and as a convenient way to get stuff off your laptop when you are away from home. But nothing more than that, at least in the eyes of this grizzled commentator.

So what is the best thing to do? Well, if you have a PC or laptop at home, make sure it's joined to the same Dropbox/OneDrive account, so files are synchronised as they change.

This is better, because it protects you against loss of the cloud service. But it hasn't really helped in terms of that sort of nasty ransomware. You'll still have only the current version of your local file.

Snapshot in time

At this point, we start to talk about your backup and archive solution, because it's this that you'll be turning to if the worst happens. And so I thought it was worth having a chat about file system snapshots, what they are and why they're useful.

First, you need to have a leap of faith. We're all used to the simple concept of a file being written down onto a disk. There's a set of directory entries, and the data is in blocks on the disk surface or within the structure of the SSD drive. If you change part of the file, then often it isn't necessary to rewrite the whole file, but just to append the part of the file that's changed.

Now let's go one layer of the onion further out. Imagine that you can track the changes to the blocks when a change is made; rather than just writing them over the original data, how about keeping them separate? So you have the original file, and a



set of blocks kept separately that represents the new version of the file?

Time for the even bigger leap of faith: if you think about it, the file now exists in two versions. The original and the newer one, which is a composite of the original file plus the changed blocks. Now let's take this idea and increase the scope to the whole file system, or a share on a server, which is obviously a subset of the whole file system. With a share, you might attach to it with a URL such as //servername/sharename and have some username and password credentials. The precise //etc will depend on which operating system you're using. On a Mac, it will be smb://server/share.

So with this share, you have your stored files. Over the course of a day, you make changes to these files. At some predetermined time, maybe the middle of the night, you create a snapshot. This is the point in time that says "no more changes to the base files, everything now goes into changed blocks". So the following day, all the changes are in the changed blocks for that share, and the original version of the file system exists exactly as it was moments before the snapshot command was issued.

If something were to go wrong on the second day – if, for example, some ransomware decided to encrypt all your files – you could simply go back to the previous day's snapshot and use that instead. You might roll back the entire share to the known good position. Or look into a file system viewer, walk through the file system and find the specific file you wanted from the previous day.

Now let's allow snapshots to be taken of snapshots. So at the end of the second day, another snapshot is made. Changes on day three are thus independent of day two and day one, being an appropriate composite. But you can still go back one or two days to get the earlier file.

All of this is actually reasonably straightforward once you get your head around it, and is obviously massively better than the "just the current version" that you normally get in the file system of your choice on your desktop or laptop.

It therefore makes sense to really use this capability as part of the broader set of data management and recovery tools, both to protect you from malware but also from "oooooopps, damn!" moments, or even from data corruption caused by bad software.



ABOVE Don't leave your laptop on a train or in a taxi with no backup plan in place

NAS to the rescue

Let's now bring this into focus with a complete solution. You do all of your work on a laptop, and it travels with you. Your data is at risk because the laptop might fail, get stolen or dropped, or be left on the back seat of a taxi.

The obvious solution for someone on the move is to synchronise with a cloud service such as Dropbox or OneDrive, but then to ensure that you pull down from that to a local storage under your control, and for this to support snapshots. Clearly the sensible solution here is a NAS; I use Synology, but there are others such as QNAP. Or you can build your own and use one of the open-source NAS platforms. I know there's a group test in this month's magazine (*see p80*), so the timing couldn't be better.

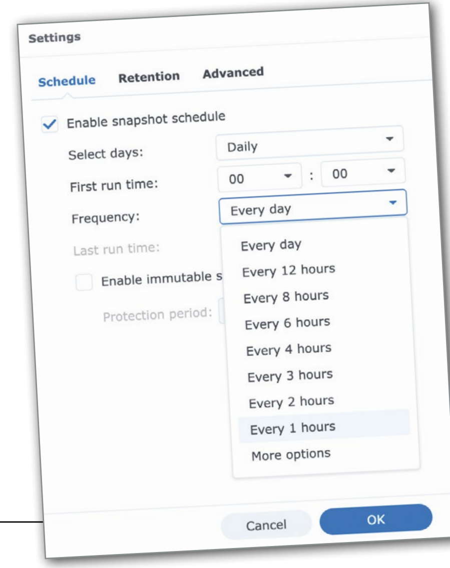
In my case, having set up the Synology I use the Cloud Sync service to log into the cloud service of my choice, whether that's Dropbox or OneDrive.

"All routes are possible, but you need to consider which is most appropriate"

Then get it to pull everything down in near real-time. Or I can set it to be every few minutes, or even to snooze overnight if required. There's a choice to be made here, too: should the sync be bidirectional, so changes made to the relevant share on the NAS are sent up to the cloud storage, and then out to the laptop? Or should the NAS be treated as a read-only service? This is my preference, so any bad changes made to the NAS, for whatever reason, won't be pushed to the cloud and out to the laptop, compromising the data.

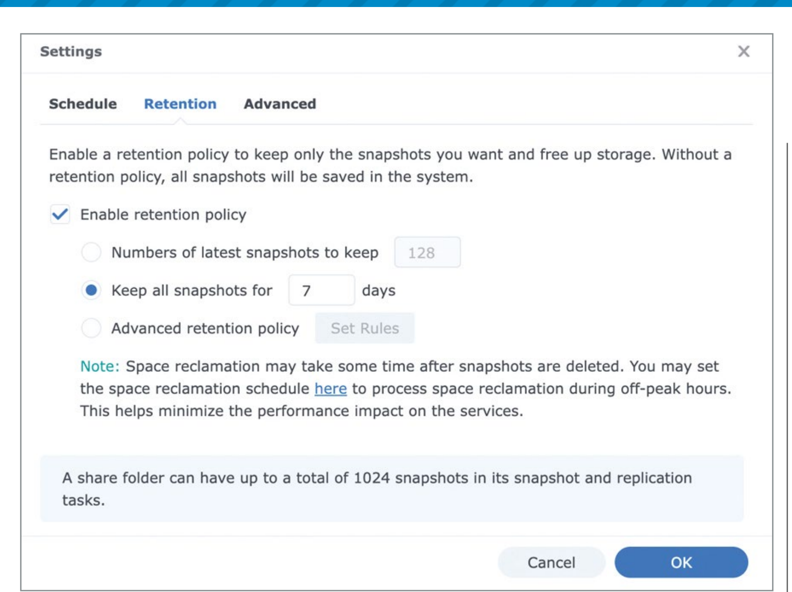
However, if you have a desktop computer at home, you might want to access the OneDrive/Dropbox share on the NAS as raw network storage, and then have the NAS push the changes up to the cloud and hence out to the laptop. All routes are possible, but you need to consider which is most appropriate to your needs.

Having got the replication service working and a NAS holding a copy of the data, it's time to turn on the file system snapshotting capabilities for that share. There are some key settings to choose here: for a start, how often do I want to take a snapshot? For most people a daily snapshot is probably going to be enough. If there is a high frequency



BELOW How often do you want to create a snapshot?





ABOVE One of your big questions is how long to keep the snapshots for

of change to the data, then it might be necessary to run this more frequently. Synology offers me all the options from daily down to a few minutes, but remember that not only does the snapshotting process take time, it will also take a small amount of storage.

Next question: how long do I want to keep the snapshots? In other words, you need to set the retention policy. It might be simple to keep a fixed number of snapshots; 128 is usually a good number. If it's a daily snapshot, then that's quite a few months. If you're going for hourly during the working day, then your history time window will obviously be shorter.

Or consider an Advanced Retention Policy. I quite like the defaults of "keep all snapshots for one day", then "keep the latest snapshot of the house for 24 hours". Then "keep the latest snapshot of the day for seven days". Weekly for two weeks, monthly for a month and then yearly for one year. This is quite a well-balanced plan that will run well over time.

Putting it all together

Now to finally pull all the pieces together. You have snapshots, and each of these are invisible to the file system of the user. So local malware on your laptop or desktop shouldn't be able to access and hence corrupt the older snapshots, even if it can take out the current view. But what if you want to get to a previous file? Well, the easiest way is to make all the historical snapshots for the share visible in the file system view, and then you can drill into the one that you want to recover the file that you accidentally deleted. But don't leave this view open all the time, otherwise malware could see it too, and the whole reason for doing this has become compromised.

Are we done yet? Not really. Think about the risk analysis at this point. Your laptop wanders around with you, and all data is synchronised to the cloud. The NAS is pulling this data down on the time scheme you define – I quite like real-time here. Then the file system of the synchronised share is getting snapshotted on a rule set that we have defined.

If the laptop dies, the data is still in the cloud and on the NAS. If the cloud dies, the data is on the laptop and on the NAS. If the laptop gets infected with malware and ransomware, then the problem will almost certainly replicate to the cloud and hence to the NAS. But you have the NAS snapshots, which will allow you to roll back the problem and recover the data appropriately. This is obviously not something to be done in haste, but with a well-rehearsed recovery plan.

If you want to go further, then there are options open to you. A second NAS on your network, maybe squirrelled away in the garage or the loft space, opens up a whole new area of backup and recovery facilities that exist in the NAS world. Why not replicate the snapshots across to the second NAS, so that it's available live on the network if the first NAS drive gets corrupted? Or use the cloud backup capabilities on the NAS to push your data out to a second cloud service? I like to use the Synology C2 cloud service using the Synology HyperBackup tool, which keeps a full machine copy in the cloud of the entire NAS. Or just the bits that I want. Use whichever cloud service you like; the list is impressive and includes C2, Backblaze, Dropbox, Azure, S3 and more.

"It's clear that data isn't really very important until you can't access it any more"

Or you can go over the top and replicate within your LAN to several NAS drives. And to both Backblaze and C2 as well.

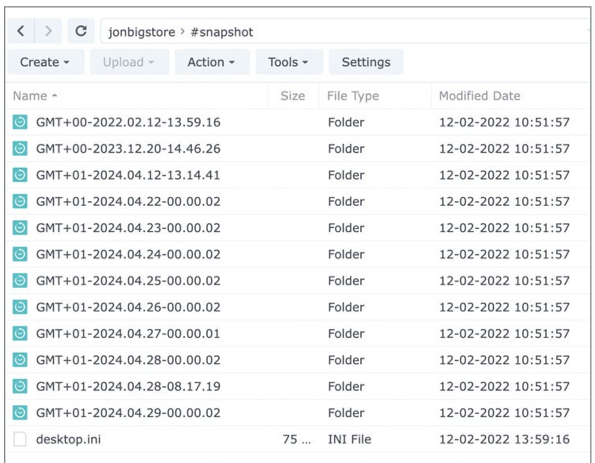
When it comes to handling your data, only you can decide what is important to you. From experience, both of losing my own data and also helping friends who have experienced problems, it's clear that data isn't really very important until you can't access it any more. And then it becomes irreplaceable.

Going full circle

And to go full circle, this is one reason why I am a huge fan of a NAS drive on your network. It doesn't have to be a hundreds of terabytes monster. It can be a little two-drive unit (because drives must always be mirrored or in RAID) and cost only a few hundred pounds for 8TB of storage. But the most important part is building up a picture of where your data is and how you can protect it. And snapshotting within the file system is an excellent way of providing fast access to previous files, and also to keep that historical data away from malware attacks. It doesn't replace backup/archive or off-site replication, but it is a tool to be used as part of the same orchestration.

It isn't difficult to set up and use, but you'll need a big piece of paper and a marker pen to draw out the data flows of your network, and to have a really clear understanding of the points of exposure. And then how you are going to mitigate those risks.

BELOW Browsing through previous snapshots on my Synology NAS







Windows support

So Microsoft appears to be rolling out its advertising plans for Windows 11.

I have one short, pithy answer to that: no. I appreciate that Microsoft is between a rock and a hard place when it comes to monetising Windows in the home and small business area (as opposed to larger businesses, which are tied into rolling licensing). Redmond wants its slice of the pie. Still, though, no. That's a shortcut to alienating your users.

Something that it again seems keen to do for everyone on Windows 10 hardware, as this will shortly go into "unsupported mode". There's a lot of perfectly good hardware running Windows 10 that can't upgrade to Windows 11, with my 27in Dell XPS all-in-one a perfect example of this.

This led me to head over to the specifications page for Kaspersky's internet security platform (**tinyurl.com/358kaspersky**) to discover that it's supporting Windows 7 SP1, 8, 8.1, 10 and 11. Trundle over to Avast (**tinyurl.com/358avast**) and it's the same story: Windows 7 or later. And it's the same for ESET (**tinyurl.com/358esetlink**).

This opens up a very interesting question. The major antivirus security companies are supporting three versions of Windows that are already out of support. Now we can argue that Windows 8 is a sideshow here, because the big ones were 7 and 10. They might drop support for 7 when 10 goes out of support in 2025, and that would be understandable.

But what does Windows support really mean for the home/soho user anyway? Microsoft might not provide kernel security fixes, but isn't that why you have a comprehensive antivirus/security package from a third party? At least, isn't that the marketing line for these companies?

It might be unwise to have your browser out of date, but Google supports Chrome on Windows 10 still. So does Firefox.

Are we going to see customers just roll on as if nothing has happened, and rely upon AV security companies for their protection? I'm not sure I like that idea, but given that these companies are still supporting Windows 7, it opens up a whole bunch of questions.

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LEE GRANT

"I believe the current implementation of Windows Update is the best it's ever been"

We decode the enigma of Microsoft's updates to win a USB boost before placing a peg on the nose to tackle a blocked printer with an unusual smell

Talking about Windows Update's deficiencies feels somewhat cheap and predictable. Windows Update-bashing bobs around the cliché-mire along with shooting fish in barrels and stealing candy from babies, but sometimes nonsense needs to be called out.

Over the course of a month, I'll get my hands on machines of wildly different configurations, and I'm always impressed that Microsoft's much maligned updates don't cause many more problems than they do. However, when Microsoft pushes an update that doesn't fit like a velvet glove, it's only a matter of time before the phone rings with customers reporting similar issues. Recently, this has happened twice.



Lee Grant and his wife have run a repair shop in West Yorkshire for over 20 years
@userfriendlypc

Will the real USB 4 please stand up?

In February, Microsoft released KB503484, which included a few tweaks to improve networking, mobile connectivity, backup and an issue with long-edge fed printers. But the headline feature for KB503484 was its introduction of 80Gbits/sec USB 4 performance to machines that have the hardware to manage such a miracle. Judging from the calls I received from frustrated customers, Microsoft is welcome to shove its USB implementation where the sun don't shine.

Typically, when a customer started their machine, Windows would invisibly scurry away, download KB503484 and prime it for installation during the next reboot cycle. During power off, Windows displayed the percentage messages we adore alongside a slurry of reassuring words informing us it's busy installing and that prematurely powering off the PC will cause the world to end.

For most users, Windows would reboot and all would be well. For the less fortunate, the next time the machine powered on Windows would continue installing until around 97% before slipping on a banana skin and being forced to concede via the calmly reassuring message that "Something didn't go as planned. No need to worry. Undoing changes. Please keep your computer on."

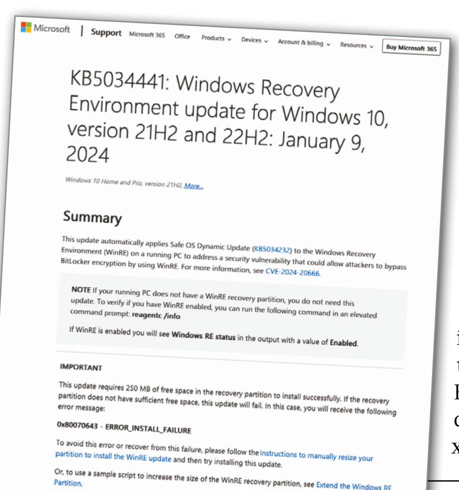
"The patience and good nature of the average Windows user is greatly tested"

At least Microsoft was telling the truth, as Windows would eventually reappear with full functionality, completely unscathed from its crash. The patience and good nature of the average Windows user is greatly tested when it takes ten minutes for a machine to perform a startup. One customer whose Windows 11 machine had left our shop only six weeks earlier clarified the situation perfectly: "It's not your fault love, but it is your problem." Well, quite.

If you ever wonder how tech companies make so much profit, it's because they've constructed an environment (via the EULA) where they can break your machine with an update and either you or your friendly neighbourhood computer shop will be paying to fix it. The solution to this gremlin was a straightforward strategy that I've used to haul many machines out of update craters but, as Windows is more successful at installing updates than it used to be, it's a technique that many have forgotten.

Squirrelled away in the dark recesses of the Microsoft website is its update catalogue page (**catalog.update.microsoft.com**), which looks old and primitive compared to the rest of the site, but it's a search tool to download offline install packages of (most) updates. Searching for the KB503484 displayed download options for x86, x64 and ARM variants, so I

BELOW Microsoft's update catalogue is a useful online tool



Microsoft | Support Microsoft 365 Office Products Devices Account & billing Resources Buy Microsoft 365

KB5034441: Windows Recovery Environment update for Windows 10, version 21H2 and 22H2: January 9, 2024

Windows 10 Home and Pro, version 21H2, More...

Summary

This update automatically applies Safe OS Dynamic Update (KB5034232) to the Windows Recovery Environment (WinRE) on a running PC to address a security vulnerability that could allow attackers to bypass BitLocker encryption by using WinRE. For more information, see CVE-2024-20666.

NOTE If your running PC does not have a WinRE recovery partition, you do not need this update. To verify if you have WinRE enabled, you can run the following command in an elevated command prompt: **reagentc /info**

If WinRE is enabled you will see **Windows RE status** in the output with a value of **Enabled**.

IMPORTANT

This update requires 250 MB of free space in the recovery partition to install successfully. If the recovery partition does not have sufficient free space, this update will fail. In this case, you will receive the following error message:

0x80070643 - ERROR_INSTALL_FAILURE

To avoid this error or recover from this failure, please follow the Instructions to manually resize your partition to install the WinRE update and then try installing this update.

Or, to use a sample script to increase the size of the WinRE recovery partition, see Extend the Windows RE Partition.

made my choices, ran the download and the update gods smiled once more. Offline installers are a useful tool in the repair community, so remember that option if your machine hits a brick wall.

Before we move on, I want to highlight a curiosity about KB503484's implementation of USB 4. The update enabled 80Gbits/sec, doubling the existing 40Gbits/sec, and Microsoft was proud of this boost, mentioning in the press release that it's "fully backwards compatible with peripherals built for older generations of USB and Thunderbolt and works alongside all other USB Type-C features".

Great, so that's USB 4 at 80Gbits/sec with backwards compatibility, but Microsoft's PR machine is quiet on an important aspect of the USB implementation. 80Gbits/sec is the highest transmission speed in bi-directional mode of the USB 4 v2 spec, but its party trick is the ability to switch into asymmetrical mode, which will do 40Gbits/sec in one direction and 120Gbits/sec in the other. In pure marketing terms, 120 is a bigger number than 80, so I find it odd that Microsoft is doing cartwheels over the smaller number.

I haven't yet had a chance to test KB503484's speed for myself, so I don't know if Microsoft is hiding its light under a bushel or has hobbled the spec. I'm sure all will become clear in time.

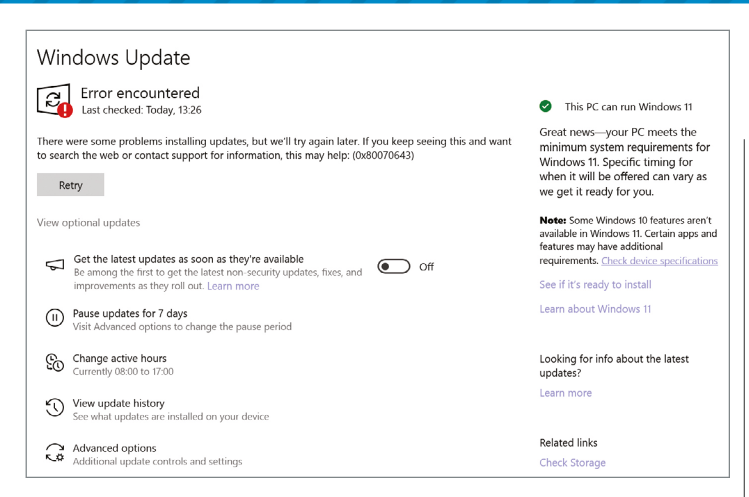
Windows Updates: you've never had it so good

At the risk of flooding the *PC Pro* mailroom with complaint letters, I feel the need to admit that I believe the current implementation of Windows Update is, with one small exception, the best it's ever been. Today, it's possible to pour the standard Windows 11 image into unimaginable combinations of hardware and the OS will make a pretty good fist of identification before Windows Update scuttles off to fill in some gaps. Partly this improvement is down to the massive amount of hardware ID data inside the OS image, but Windows Update augments this to deliver a great user experience. And yes, I'm being serious.

For those yearning for a return to the halcyon days of XP, I ask you to recall how poor that OS was in the art of identifying hardware. Windows Update was rendered useless as XP was notorious for failing to recognise network connectivity, so a pile of drivers on USB sticks was required before the machine was usable.

Windows 98 was even worse. To get the USB drive working, you often had to install USB drivers, which was fine for people like me that had access to multiple machines, working internet connections and CD burners. If you were at home with a rebuilt 98 system whose AOL installation CD couldn't find the unidentified 56K modem, then the best solution was to flash the Bat signal onto a cloud in the hope that help would arrive.

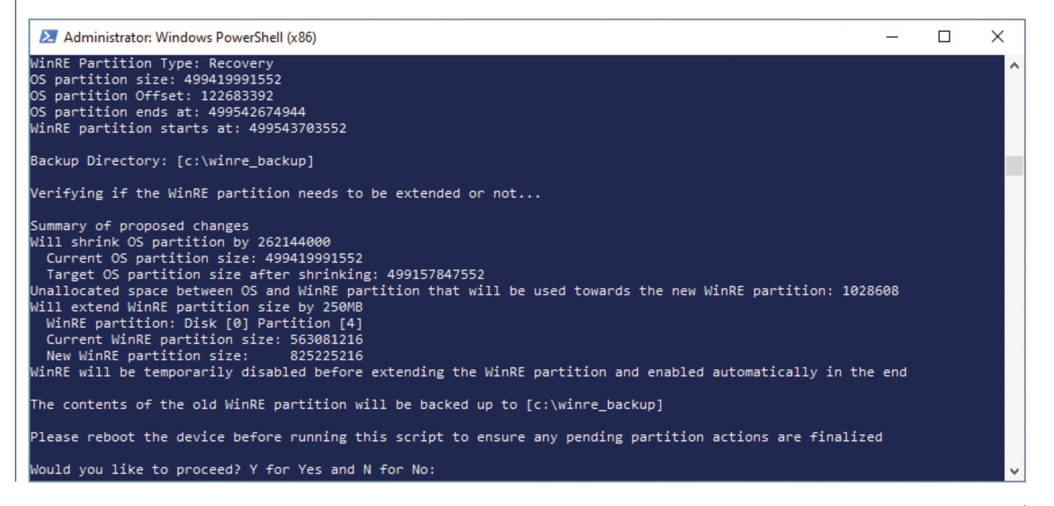
Where the 98 and XP versions of Windows Updates were superior was their ability to untick a box to instruct the system to ignore the update. Currently, the only way to do this on Home editions is to go Registry hacking or use a third-party app such as WAU Manager from Carifred (**tinyurl.com/358carifred**). Microsoft used to develop a Show/Hide Update Tool, but it abandoned development a few years ago without replacing it.



ABOVE Windows Update errors often make the phone ring

"Microsoft's prescribed solution to the update failure was bizarre"

BELOW Good luck interpreting the PowerShell instructions



You want me to do what?

The other update that has been causing Windows 10 clients a headache recently is KB5034232; this is a security update to resolve CVE-2024-20666, which could allow BitLocker encryption to be bypassed from WinRE. If you're unfamiliar with WinRE, then it's the Windows Recovery Environment that's home to all those blue-screen options that appear when Windows has gone wrong.

Unlike the previous example, the failure of this update to install didn't cause unacceptable delays with reboot cycles, just a constant stream of failures in the logs, but Microsoft's prescribed solution was bizarre. Its tech note (**tinyurl.com/358update1**) says that for the update to succeed, the machine needs to have at least 250MB of free space on the drive's recovery partition. Microsoft provided instructions on how to achieve this using a 20-step list of lengthy command-line options to coerce the REagentC tool into making changes.

Isn't it odd that Microsoft hasn't advanced Disk Management from the Windows 7 version and that Windows 11 still lacks a usable GUI for tweaking partitions as there is in virtually every Linux distro? For those that don't fancy destroying their drive layout with a typo, Microsoft provided a sample script that will automatically extend the WinRE recovery partition (**tinyurl.com/358update2**). The less than clear instructions use PowerShell to execute the script and, if you ignore the plethora of red error messages that have flashed up each time I've whistled through the process, you'll spot that a 250MB recovery partition is summoned into existence.

Kudos to Microsoft for creating a script that seems to work, but I've yet to see this solution cure the original problem. Most machines since Windows 8 use a GPT disk layout, so



already have a suitable partition of an adequate size, so I'll gladly raise a glass to toast Microsoft's valiant attempt but only tip my hat to acknowledge MBR and other layouts as a full explanation is something that none of us needs to endure.

The fix to KB5034232 refusing to behave is less convoluted than Microsoft's, slightly less elegant but scores major points because it actually works. Head to the Windows 10 Media Creation toolkit (**tinyurl.com/358toolkit**), select the relevant options on language and download the Windows 10 ISO. Mount this file, open the image in File Explorer and run Setup.exe.

It will whirl around for a while and eventually give you the option to "Install Windows 10" and (critically) "Keep personal files and apps". Clicking Install will begin a process that XP veterans will recall as the "Repair Install" option, which is a method to refresh the system without wiping apps and data. Once complete, your system will look and operate exactly as it did before, except that KB5034232 will install.

Persistent printing

A laptop arrived in the shop last month with a peculiar quirk of Google Chrome trying to print to devices that had long since departed from the customer's house. The devices listed in Chrome's print dialog box were a blend of old and current all-in-ones, but whichever option was selected, either nothing happened or a PDF was created. To the customer's credit, they'd reset and reinstalled Chrome, but the problem persisted.

It had been many years since I'd seen this problem, leaving me to believe that Google had eradicated the fault during the many modifications to the browser, but no, I was wrong, yet it's not the fault which amused me. If you squirrel away into the folder located at C:\Users\Username\AppData\Local\Google\Chrome\User Data\Default, you'll find a JSON file (**wikipedia.org/wiki/JSON**) called Preferences. This can be opened in a text editor, but it will break the JSON formatting and make it seem like a parade of drunk chickens have tap-danced over your keyboard.

The code responsible for printer history is in "recentDestinations" but, due to the lager-fuelled poultry, it's tough to spot. I know what you're thinking. Why didn't you press Ctrl+F in Notepad so we can all move on? I did and we can't. Notepad popped up a message on the screen, "Cannot find 'recentDestinations'", which was disappointing, especially as this message appeared just above a line of text that read "recentDestinations". Like Windows Update, Windows search prowess is often the butt of many a joke, but as it clearly couldn't find its butt with both hands, it's a position that is hard to defend.

Samsung masters hide and seek

What features will you be looking for when you next buy a printer? Low running costs? Rapid output? No burning smell? When the owners of a Samsung laser printer arrived in the shop cradling their device, they were saddened that their trusty workhorse had developed a limp. A paper jam meant that the device no longer functioned, but the owners were also displeased about the unpleasant odour that accompanied each page.

I'll be honest, smelly electronics don't get my heart racing. I still recall the monitor that exploded on my bench many years ago, which resulted in a frank conversation with its owner about it being full of cat urine. This Samsung also had a pet allergy as a considerable amount of fur had worked itself into the device, including the fuser unit, which applies heat to fuse the toner to the paper.

Some laser printers run much hotter than others, so detritus heats up and, well, stinks. By chance, the paper jam was deep inside the device and as I began pulling off the printer's panels, I wondered how a firm with the technical brilliance of Samsung could design a paper transit path that wasn't fully accessible. I had to remove all the cowlings, the paper tray, circuit board and fuser to retrieve a ball of paper no bigger than 1cm.

On this printer, the paper passes through an area that's inaccessible unless the device is in pieces, which is normally an annoyance, but on this occasion it gave me the opportunity to remove the remnants of half a Shih Tzu with an air hose. Once I'd cleaned the rollers with a liberal application of isopropyl alcohol and rebuilt the device, the printing resumed with the usual odour of heated rubber rollers.

This thought generated a copper-bottomed idea that, for now, I'll only share with you and your fellow *PC Pro* readers. Why don't laser printer manufacturers build a recess into the fuser where a few drops of incense oil could be heated? When printing a stressful resignation letter drop in some soothing ylang ylang, or perhaps some smoked cedar for pre-gym invigoration while 40 pages of invoices are spat out. In anticipation of the guaranteed goldmine of my Atonertherapy patent, in next month's issue I'll share my top five tips on how to keep super-yachts free of barnacles. Ciao x

ABOVE You're lucky that you can't smell this issue of *PC Pro*

"It will make it seem like a parade of drunk chickens have tap-danced over your keyboard"



LEFT Even Notepad was unable to find "recentDestinations"

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ROIS NI THUAMA

"The whole thing stinks. It has all the hallmarks of the tail wagging the dog"

Who do you call if someone hits your car? Check before hitting that link, as what looks like your insurance company may be someone else entirely

A few months ago, on a sunny afternoon in the middle of the week, I sat parked up at the supermarket finishing a call with my friend and associate. By some coincidence it was the same friend who introduced me to *PC Pro* some years ago. The conversation was rudely interrupted by an unmerciful smash and me and my car heading sideways. Not forward. Not backward. Not by much. But sideways.

I looked over my right shoulder to see a driver reversing out of the side door. As she reversed, presumably to remove herself from the scene, I hopped out, shaken but not stirred. There I stood, phone in hand attempting to record what can only be described as a slow-speed escape.

Startled that there was anyone in the car, the driver continued reversing. I waved my hands in the air like a character from *Team America*. You get the picture. What then occurred was a rather amusing exchange where the driver asked if our cars had touched. Surveying the damage and pointing it out, I looked to clarify the language. Our cars hadn't touched so much as she had smashed her car into mine. If that's the kind of violence that she would describe as touching, I pitied her husband.

The driver processed this for a moment and then proceeded to blame my parking. My response was to point out that even if my parking was objectively the worst case of bad parking ever, it would not give her licence to drive her car into mine. So far, so wacky.

But this singular mishap caused by – who knows what? Day drinking or a moment's inattention? – isn't the point of this article. The point is much more nefarious. Because what happened next is the sting.



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@rois_cyberstuff

I searched online for my insurance company's details using the keywords: the name of the insurance firm and accident report. The name of the insurance company is immaterial. Because what happened next was outside of its control.

I clicked on the first link – a 24-hour support and accident claim line – and went through to an operator who answered, "Accident reporting line, how can I help?"

The questions that followed were the standard questions that you would expect in an event of this kind: name, address, date of birth, car registration and an overview of the events as they unfolded. The other side's name, registration, telephone number. Essentially all the material facts of the case.

Then the operator said that they would be acting on my behalf in this matter. Woah, slow the horses right down. I asked which company I was speaking with.

"You've come through to the accident report line."

"For [my insurance firm]?"

"No. We're an accident claims firm."

"How is it the case that when I searched for my insurance company using its name I got through to you?"

"The parasitic business invests nothing into building its own brand"

Brand name and reputation

While this isn't a direct assault on a brand, being able to divert opportunities intended for Company A by piggybacking off its brand and reputation represents a significant commercial disadvantage for that firm.

This is particularly the case where, in tough market conditions, Company A has invested large sums of its capital into a series of activities to generate goodwill and business. This typically includes activities such as marketing, branding, corporate sponsorship, staff training and measuring and improving response times, to name but a few.

For another firm to be able to exploit Company A's investment and attention to detail by positioning itself at the top of a results page to link to its own firm for a few shillings seems, all things considered, inequitable. This inequity is more striking in sectors that are heavily regulated, such as insurance.

The parasitic business invests nothing into building its own brand or developing talent. Instead it derives benefits without any of the burden or responsibilities of building a business. To compound this, the government doesn't even get the treasure, as the parasitic firm simply pays a fee to the search engine firm, which is usually based overseas. So now both the country and the company lose out.

Simultaneously, the rights to determine which firm is ranked highest based on keywords, which include protected brand names, sit with an overseas search engine firm. How did we end up in this position?

The law has long regarded passing off as a harm done to commercial enterprise. To succeed in a passing off action, the claimant needs to establish



RIGHT Had a prang? Don't make things worse by calling the wrong company

three elements. First, goodwill or reputation (you'll have to accept that my car insurance firm is a well-known household name of some repute). Second, that the claimant can demonstrate that the defendant has made a misrepresentation (whether intentional or not) that leads, or is likely to lead, the public to believe that the services are the services of the claimant. And finally, damages – for example, demonstrating loss of earnings or an erosion of the distinctiveness of the claimant's brand affecting the ability to command a premium price. Check, check and check.

But wait, there's more...

This isn't an isolated incident. In fact, I've searched for EU regulation recently and discovered a worrying trend. There are two hot topics for information security professionals right now, both with looming deadlines: the Digital Operational Resilience Act (DORA) and the Network and Information Security Directive (NIS2). Inputting either of these terms into a search engine is revealing. And maddening.

Instead of returning the EU's repository of regulations and directives, it returns a raft of cybersecurity companies that have gamed these important keywords for their commercial advantage. Getting to the black letter of the law should be a straightforward matter.

To check my position and to discuss the broader implications, I reached out to Susan Martin, former president of the Dublin Solicitors Bar Association and one of Ireland's leading boutique litigators. In her opinion, the issue with this "optimisation" of keywords that are associated with regulated services is that it ultimately impacts the consumer. In this instance, the insured enters their insurance company's details and is diverted away from the firm rather than landing on the actual page of the firm they searched for. That's troubling. My view is that there's little difference between that digital sleight of hand and someone opening a shop and putting a Harrods sign above the door. It's astonishing that it's permitted.

It is, Martin continued, inadequate that the company uses the word "sponsored" at the top of the page; rather it should contain a clear warning. Martin points out that the cost for any search engine company to add a warning would be tiny, while the clear benefits to the consumer would be enormous. Essentially, as I'd described it, Martin added, these firms, which aren't regulated, seek to indicate or imply a relationship with an activity, event or document that forms part of a regulated industry.

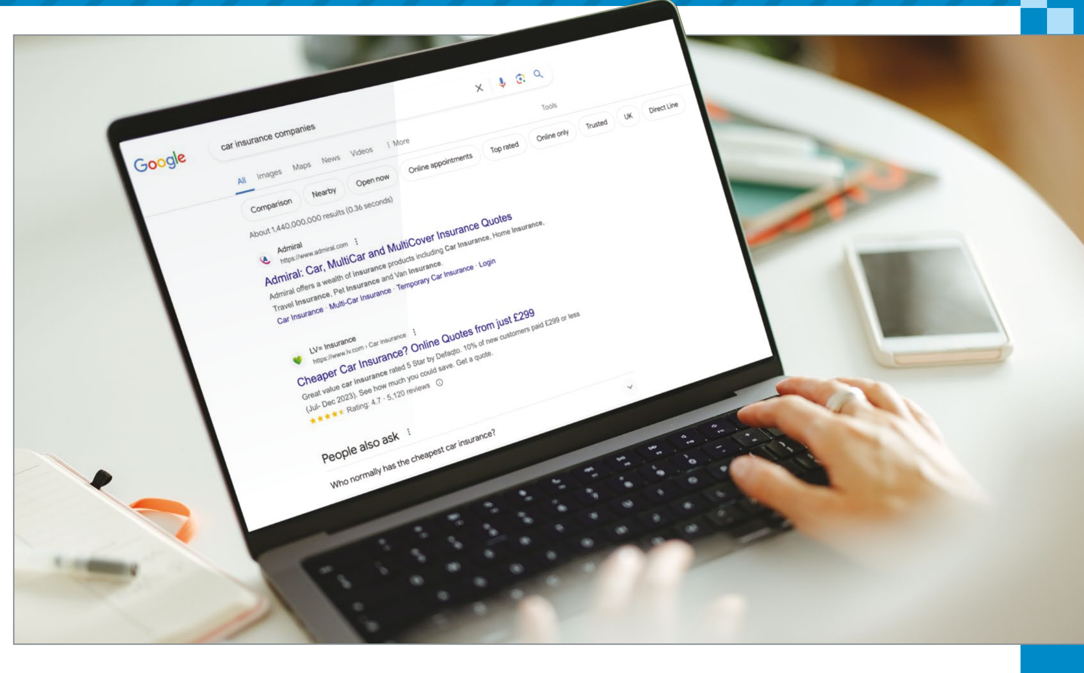
We're talking on Zoom. I nod enthusiastically. Precisely my point, counsellor, well put.

At a minimum, it would be reasonable to expect that a search engine would return the firm searched for or the regulation or directive in pole position. As with insurance, legal services and the provision of advice are subject to heavy regulation. It's not for enthusiastic marketing managers to interpret the law, however well intentioned they are.

Page? Rank. Yes, it is rather

The whole thing stinks. It has all the hallmarks of the tail wagging the dog and the implications for businesses are clear. Spending money on building your brand awareness may offer a return on your investment for firms whose directors are indifferent to how their own brand is perceived, but perfectly willing to leech off the hard work of others.

This is not a criticism of search engine optimisation (SEO). It can be very useful for businesses to engage in and explore ways in which they can optimise their web pages. Not only is this exercise invaluable for the firm as it seeks to clarify its offering, vision and values; it also provides the consumer with insights to help them make informed decisions. These decisions should be based on thoughtful consideration and copy that explains what they do, how they do it and, importantly, who they are. But clearly this isn't happening here.



ABOVE Search results are often not what they seem

> "It would be reasonable to expect a search engine to return the firm searched for"

BELOW Does the digital age need a new passing off definition?

So, rather than being a criticism of SEO, this article is a denunciation and articulation of a clear and worrying trend towards what could be described as search engine exploitation.

This exploitation of keywords and sponsorships by parasitic businesses will, if left unchecked, drain the value from the entity driving growth and value and, as Martin points out, jeopardise consumer options by limiting choice while offering them the appearance of choice. In a good set of hands, there's a case to be made for a new species of passing off in the digital world. No firm should be able to use another firm's name in their keywords. No firm should be above the named firm in search results. That is precisely why businesses trademark their names and logos, so they cannot be abused or used by charlatans.

It's all a bit *1984* or *Alice in Wonderland*. I can't decide and now I need to go and have a lie down.

My final words are reserved for the search engine companies that took an early lead. It may well benefit them to recall how they won that lead. They won because they returned useful, pertinent results that reduced searching time, and delivered value by maximising searcher satisfaction through the alignment of the results with the keywords. And however awful Ask Jeeves was – and it was awful – I was never provoked to write a forceful condemnation of it.

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DAVEY WINDER

"There's always a cost involved, and this cost is related to privacy"

Davey dumps Gmail and goes Swiss for improved privacy and security. The question is, should you do the same?

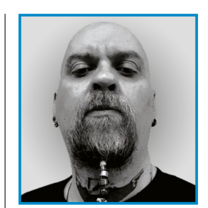
Regular readers will know that I've been something of a Gmail evangelist for a long time. With almost 2 billion users worldwide, it is the largest email provider, easily surpassing Proton Mail's not-unimpressive 100 million users. The reason behind this popularity is its ease of use, its configuration, and the fact that it's free.

Well, kind of free. There's always a cost involved, and this cost is related to privacy. While using Gmail, you might have to compromise on your privacy to gain the full benefits of the service. But if you're willing to trade off privacy concerns with the benefits of using Gmail, then there's no doubt you'll enjoy the productivity and convenience that it provides.

Gmail is also an excellent choice if you're looking for an email client that's in sync with other parts of the Google ecosystem. But there's no escaping the fact that data collection is part of the deal, albeit to improve Google products as well as to personalise adverts. Google says that it offers "personalised and assistive experiences, such as Smart Reply, by processing some data" when you use Gmail, but your information stays secure and users can control privacy settings for their Google account.

While Google says it doesn't "scan or read your Gmail messages to show you ads", it does display adverts in the promotions and social tabs, "elected to be the most useful and relevant for you". This selection process is fully automated and based on online activity while signed into Google, and past ad interactions are stored to "avoid showing you the same ads and show you ads you may like better".

I don't think that Gmail is a bad choice of email client when it comes to security, and it's an area Google



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"Proton Mail is at the top of my list for security, privacy and usability"

continues to improve, but there are better choices; Proton Mail is at the top of my list for security, privacy and usability, although to get the best from the service does require a paid subscription.

Proton isn't free but you get what you pay for

Let's address the elephant in the inbox: cost. You can use Proton Mail free of charge if you want, and it's a good way of getting a feel for the software before subscribing. However, be aware that it's very much the skimmed rather than full-fat version, so you'll miss out on features that make Proton Mail my primary email client of choice.

The price-comparison table at Proton (**proton.me/pricing**) shows the Free account has only 1GB of mail storage compared to the 15GB from Gmail. There's a small info logo next to this, which reveals that you start with 500MB and "unlock" more later on. There's only a single email address on offer and you're limited to sending 150 emails a day. Your free account also gives you access to "lite" versions of the Proton calendar, drive, VPN and password manager.

The paid-for Unlimited version of Proton Mail adds a fair bit, as you might expect for €12.99 per month. However, that reduces to €7.99 per month if you commit to a two-year subscription paid up front.

Let's take a quick look at the differences: 500GB of storage, priority support, access to the Proton Sentinel security program, 15 email addresses, support for three custom domains, unlimited messages. Then there are unlimited hide-my-email aliases, a desktop app as well as the mobile ones, and third-party email support (via IMAP/SMTP bridge software) for Outlook, Apple Mail and Thunderbird clients.

Obviously, you also get the full versions of the rest of the Proton ecosystem, which could be quite the value-add if you're not currently using free storage, password manager, calendar and VPN services.

Encryption at both ends of the email chain

You've probably noticed that I didn't mention end-to-end encryption (E2EE) in that comparison. This is because such a core part of the Proton Mail service is offered to free and paying customers alike. So, if you're sending email to another Proton Mail user, all communications are automatically end-to-end encrypted, but email to everyone else won't be E2EE encrypted.

Unless, he says triumphantly, you use the password-protected email feature. This does then ensure E2EE, with the recipient decrypting the message using a password known to them and reading it via their web browser. Such messages expire after 28 days by default – the sender can configure this differently – and the expiry time is displayed when reading the email message itself. As long as the recipient replies using that browser window, the reply is also E2EE.

While Gmail does use encryption by way of Transport Layer Security (TLS) for encryption while in transit – both inbound and outbound, which can mitigate eavesdropping between mail servers – there's no E2EE. There is an optional client-side encryption feature for Enterprise

BELOW The iOS app privacy table reveals the difference between Proton Mail and Gmail







Plus and Education version users, but this is still not E2EE.

Then there's the matter of encryption at rest, while data is stored. Proton Mail mailbox storage has zero-access encryption, which means that "if Proton Mail were somehow breached, user messages remain secure because Proton Mail only stores encrypted messages. In other words, if an attacker steals emails from Proton Mail, the attacker would not have the ability to decrypt them, as even Proton Mail cannot decrypt them." That quote is direct from Proton.

If you're truly paranoid there's even a two-password mode that can be activated to add another layer of protection to the signing-in process for Proton Mail. Although a single password, which you'd be recommended to bolster with added 2FA protection, is the default and is recommended for most people, I'm rather partial to a geeky threesome.

Here's how it works. First, you log in with your password; second, you authenticate your identity with your 2FA code/key; third, you decrypt your mailbox with the second password. This second password is "used to decrypt data on your device; we do not have access to the decrypted data or your decryption (mailbox) password," Proton says. "This also means we cannot hand over your data to third parties or perform a mailbox password recovery. If you forget your mailbox password, we will not be able to recover your data."

And talking of 2FA, Proton Mail doesn't allow for 2FA over SMS and insists on only using the stronger methods of an authenticator app or hardware key.

Encryption is not the only fruit for the security- and privacy-minded email user. Proton Mail is based in Geneva, and Switzerland famously has some of the toughest privacy laws in the world. Launched ten years ago, Proton came about through scientists who originally met at CERN. As such, all data remains in Europe and is compliant with the "privacy by design" Article 25 of the EU General Data Protection Regulation (GDPR), along with the firm not being liable to give access to data in cases of US or EU civil litigation.

Even if there were to be a case whereby a Swiss court decided it met the requirements for disclosure, it could only hand over encrypted emails. However, as was highlighted during a case in 2021 where a Swiss court demanded IP logs, Proton Mail can be required to start logging the IP address as part of a Swiss criminal investigation involving the breaking of Swiss law.

Encrypt message

Send an encrypted, password protected message to a **non-Proton Mail** email address.

Your message will expire in 28 days. Learn more

Password

****

Password hint Optional

Hint

Set encryption

Cancel

You have received an encrypted email from

daveywinder@protonmail.com

Learn more about password-protected emails

Expiry date

Wednesday May 22nd 2024 at 12:38:39 GMT

Password hint

None

Unlock message

ABOVE Password-protected email takes E2EE to non-Proton Mail recipients

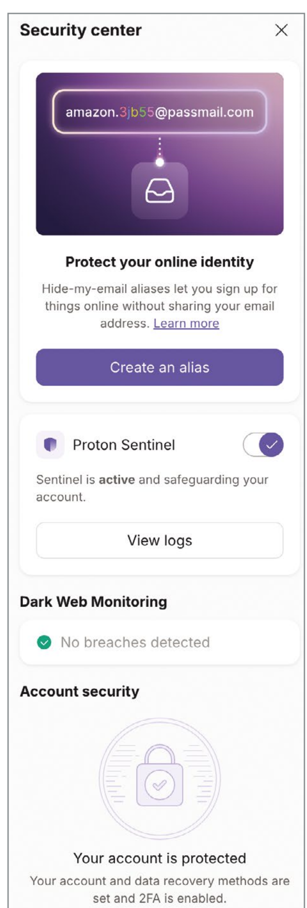
Keeping watch in the night

One of my favourite songs from *Les Misérables* is "Stars", the lyrics of which include "You are the sentinels, silent and sure, keeping watch in the night". I mention this as Gmail has an Advanced Protection option for users such as journalists, politicians and activists – the type of people who could be targeted by threat actors – and Proton Mail has Sentinel.

Google requires you to log on with a hardware security key and provides advanced protection from potentially harmful downloads. It also restricts users to app installations from verified stores and only allows Google apps and verified third-party apps to access your Google Account data, so some third-party tools may no longer be available to you.

Proton Mail's Sentinel takes a somewhat different approach to protecting high-risk accounts. If you have the appropriate subscription, such as Proton Unlimited, you can activate the advanced program, which combines AI and human analysis to help mitigate threats.

Features include stricter challenges for any suspicious login attempts and user-accessible security logs, giving visibility to account changes and logins. Any suspicious login attempts or other security events involving your account are reviewed by a team of security analysts, providing 24/7 availability. Activating two-password mode along with Sentinel protection is a no-brainer for me.



BELOW The desktop app has a security centre sidebar

Enhanced tracking protection by default, dark web monitoring optional

Because Proton Mail doesn't rely upon advertising income to fund the free services it offers, instead subsidising them by subscription fees, it doesn't need to let "advertisers watch you, build a profile on you, or serve you ads based on your mail activity". So, as you'd expect, it blocks tracking pixels as well as hiding your IP address by default.

There's some variation between the web app and mobile apps when it comes to enhanced tracking protection, with only the web app providing additional removal of known tracking links from links in email; the remainder of the features are also applicable to iPhone and iPad users.

As well as removing known email trackers, Proton Mail pre-loads remote images using a proxy with generic IP addressing and geolocation. That way you can keep images loaded with your email messages but without giving away any additional data.

Proton recently launched dark web monitoring for all paid subscription plans. Many third-party services exist – **haveibeenpwned.com** being the best known – that alert users when their email addresses have appeared in databases of breached credentials distributed on criminal forums. Proton Mail has joined the dark web monitoring throng, alerting customers where Proton email



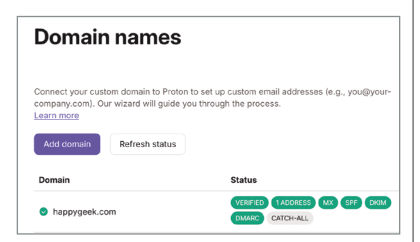
Continued from previous page

addresses have been leaked. This, Proton tells me, is the first email service to combine both E2EE and dark web monitoring, and that could well be the case. I can't recall any others making the claim, to be fair.

You can access the monitoring option through the security centre on both web and desktop clients, with one click required to open security logs. The alerts themselves include details of the personal information compromised, the source of those credentials and recommendations of what to do next.

Email authentication increasingly important

There has been a lot written, much of it by me over at Forbes, about changes in how Google deals with email authentication from those sending bulk mail to Gmail users. Essentially, bulk senders whose emails aren't properly authenticated using the likes of Sender Policy Framework (SPF), DomainKeys Identified Mail (DKIM) and Domain-based Message Authentication Reporting and Conformance (DMARC) will get bounced right back to them. Paid Proton mail subscribers can use custom email domains, and when adding these to the client users are required to implement all three.



Luckily, this is made relatively simple using a wizard system when adding the account. However, "relatively" does a lot of heavy lifting as it's still something the average user might find intimidatingly difficult. You're all geeks because you're reading this, but even so if you haven't tinkered much with DNS you'll likely still be scratching your head a bit. Proton has a really good explainer at **tinyurl.com/358proton1**, and your domain hosting service should be able to help if you ask nicely.

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STEVE CASSIDY

"We have to think about where we put our fingers and hands, and how we can keep them clean"

Could a personal Bluetooth keyboard save your life? Or at least one that includes a "clean" function? Plus, the danger of not backing up databases

I have just discovered the greatest leap forward in personal security since the taming of the pit bull terrier: there's absolutely no chance of someone scoping out your password when your keyboard grabs and throws away the first key after power-on. Especially when the device in question gives no indication that the first keystroke from "asleep" has been discarded; instead, it devotes more of its attention to a rolling lightshow of LEDs peeking out from the keycaps than it does explaining that you might want to start over with your password.

I only spotted something was up when I plugged it into my Mac Pro. OS X shows you little blobs in the password-entry dialog box, which then shake hilariously side to side to let you know you got it wrong and have only a few more tries left before being locked out. On this machine, the combination of short password failure warnings, my eccentric password-making rules and the sneakiness of the keystroke-eating keyboard saw me steal the keyboard from my Mac server and type in my password from that.

I'm not going to name and shame the maker of this comedy keyboard. It's a brand owned by a high-street computer retailer and as such needs careful preservation. Besides, if you're buying in a serious business or coding role you won't want any of its ranges of swirling-LED, darkened-room specials. Most keyboards I've seen for serious use prioritise good key travel, clear and unobstructed access to common system-specific keystrokes, and an absence of daft behaviours to make the business of logging in pointlessly confusing and laborious.



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> **"I'm not going to name and shame the maker of this comedy keyboard"**

The other keyboard that flapped onto my doormat this week was a Cherry CF104R. This is a strange object. It looks like a regular keyboard until you see that it's swathed in some kind of silicone membrane, top and bottom. The membrane is there to achieve an unprecedented level of hygiene: not just by simple waterproofing, but also by little features that help humans achieve practical, everyday improvements in their health.

For one thing, there's a function button labelled "Clean". No, it doesn't trigger some bizarre vibration mechanism to shake loose the dirt: instead, it stops transmitting any key presses until you hit "Clean" again, thereby allowing your office cleaners (or you) to go wild with the Dettol, soaps and sprays without fear of disturbing your great work, left carelessly open just when the cat walked garden dirt all over your keys.

What's that you say? "Nobody comes into our office with hands dripping with noxious, infectious substances, so we don't really need any extra-sterile or easily cleaned keyboards for our users." I love knocking down the assumptions that underpin such a dismissive verdict, mainly because they're so diverse. The range of cross-contamination events lurking in people's keyboards could include allergies to peanuts, botulism or anthrax spores, radioactive contaminants, food particles, insect eggs... Sooner or later I'll meet



BELOW Clean keyboard or clean users?

someone who objects to the idea of the anti-bacterial keyboard, and yet collapses as soon as I mention some nasty resulting ailment they're distressingly familiar with.

I believe that various surfaces and objects in the modern world are transmitting the new wave of diseases we're all suffering from. Stuff that we share with other people, or stuff that isn't easy to clean in a way that works with the materials they're made from and the daily environments in which they're used (translation: schools!). To improve our prospects in fighting off the various peculiar diseases we now see, we have to think about where we put our fingers and hands, and how we can keep them clean.

I think the Cherry keyboard is a great and necessary step forward, not just in the cliché spaces of healthcare and "administration" but pretty much everywhere I can make my pitch. We severely need to change our habits, even after the pandemic has blown through, because the parade of new and peculiar bugs isn't slowing down. A keyboard that has a fighting chance of withstanding years of use, doesn't give you RSI and can be wiped over with hand-cleaning gel is a crucial contribution to the public health situation we're all facing at the moment.

If I had to criticise this sterile marvel, it would be for the lack of optional foot-stands to increase the typing angle. The usual sacrifice we make for silicone membrane keyboards is in typing quality: even though the original Cambridge Computer Z88 "laptop" by Sinclair had a sealed membrane keyboard, his company didn't have the option of making the internal guts of the keys from moving lumps of plastic. The Cherry has that construction, making it pleasantly punchable and a lot heavier in action than the usual cheap, bottom-end moulded alternatives.

I don't consider this to be the ultimate solution to hygienic multi-user use of keyboards in public computing. Touch panel screens in shops and cafés aren't going to be superseded by this retro masterpiece; fixing the iPad sanitation problem must wait for another solution. Although I seem to have collected a funky little Bluetooth fold-up keyboard that can quickly be paired with almost any tablet, so at least my bugs won't be contributing to the general public device bug overhead. I'd like you to think about how you might follow my example, and how many different keyboards you use in a day. It could even save your life.

Not on my watch

It must be karma. The very worst behaviour I've seen in a professional career – a career that dates back to the 1980s – came to light on a network I've supported since 2008. And this problem was so close to home that it started to look more of a personal issue than a professional one.

It was all about databases or, to be more accurate, databases on virtual machines, with a dash of controversial amounts of remote access thrown in for good measure. If you missed the preamble to this story (*see issue 348, p121*), allow me to provide a simple breakdown. The database supplier, of both the schema of the databases and the coding of the client/server apps used to interact with them, managed to get themselves into a proper mess some time around 2021. In part due to the pandemic, there are insufficient records available of when its database engineer logged in or what specific commands he tried while digging himself possibly the biggest, nastiest, least repairable hole I think I've seen since the earliest days of Microsoft SQL Server.

TOP **Are touchscreen interfaces making us ill through the bugs we're sharing?**

ABOVE **Clive Sinclair's Cambridge Computer Z88 used a membrane design back in 1987**

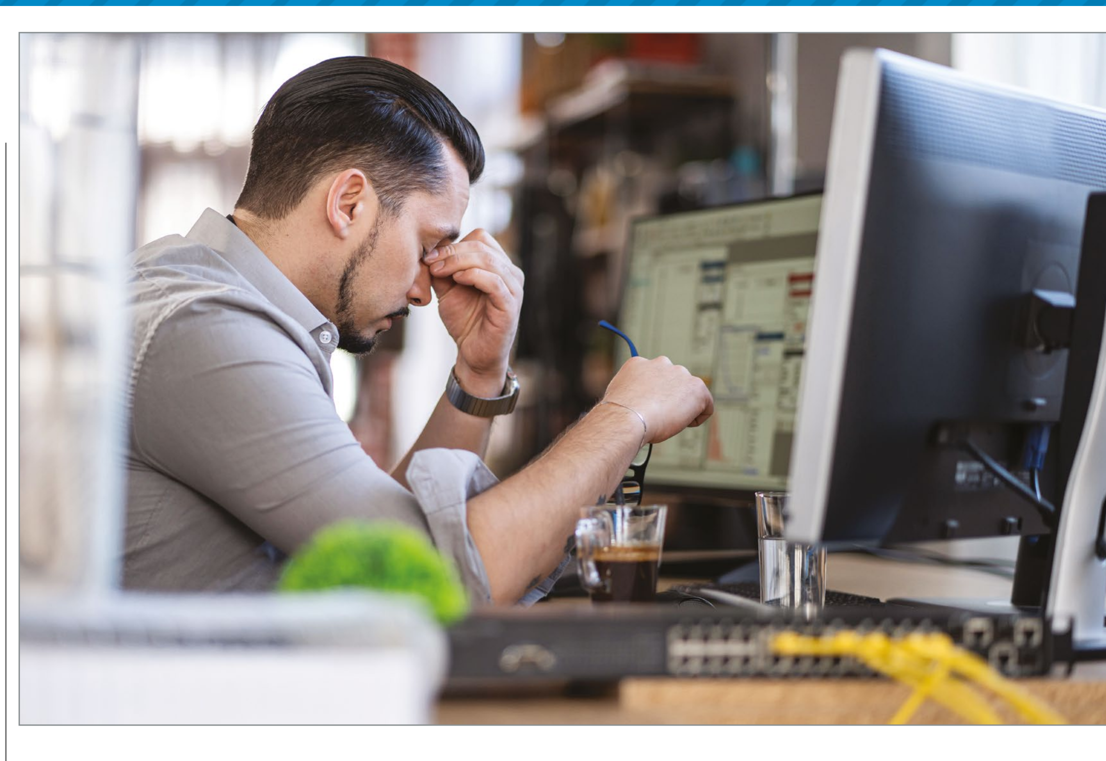
"The guy who did the work hasn't been heard from since that fateful day"

Experienced project managers won't be surprised to hear that the guy who did the work hasn't been heard from since that fateful day, now over a year ago. What's more, the various better alternatives who've had a crack at the wreckage haven't been able to make even the first blush of a decent fix emerge from the ruins. That's after more than a year!

I've taken some sneak peeks over that time, without wishing to go anywhere near making changes. From my passing inspection, it looks as if there have been three distinct attempts at importing the sizeable history of transactions and customers, going all the way back to 2008, because the various database containers all look a lot bigger than the historic trail of import/export files from other years. However, nothing was done by any of the several different data professionals introduced to us as the solution to this progressively worsening crisis.

I looked long and hard at the storage platform this had run on, both when the disastrous import was attempted, and later when the many repair attempts were all doomed. I looked, because the whole thing is written back to a cloud-connected NAS box via Windows Backup, which helpfully writes the backup as a VM disk image. And I wasn't sure that this was innocent of all accusations, because it makes use of Shadow Copy.

One good way to mess up an overly large database table – SQL or anything else – is to access it while a backup is being written of the very thing you're



touching. You really want the Shadow Copy system to instantly erect an impenetrable barrier between the backup shadow-copied materials and the live volume and data facing the SQL Server process and the client PCs.

I think of myself as a pretty cruel taskmaster when it comes to virtual machines and their disks. I've stamped on their cables, crashed their hosts, copied them from pillar to post, and they always seem to come back unscathed and intact. Yet to talk to the support and dev team of my client, you'd think that their lives were a continual round of "corruptions" and "failures", all traceable back to the chosen disk structure, storage controller and so on.

In the end we had an impasse. They wouldn't implement even the most basic performance improvements, and I wasn't about to put in their suggested all solid-state, gamer's-spec PC in the role of a server.

It took a couple of months for the boss to come out of peak season working, and suddenly my phone was blossoming with voicemails and texts. It was time for a change. He'd found another software house, with a product at least reasonably analogous to the one we'd been falling out with for the thick end of half a decade. Seemed like time for sighs of relief all round.

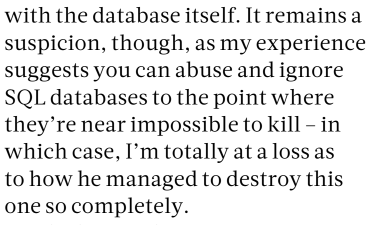
We started plotting dates for a long visit by the complete team. How tickled I was to see that its use of SQL Server was much more in line with generally accepted industry practices. In the end I configured the client a complete new SQL Server VM, a job requiring about 40 minutes of clicking and waiting. This allowed it to run its main server on the exact same hardware that the other guys had been moaning about, and I did slightly hold my breath as its configuration fired up: would all that preceding talk about corrupt stores, Shadow Copy and the like turn out to be the right diagnosis?

No. The new supplier's code is so much smarter, neater, observably smaller, and less constrained by a rigid network architecture model, that it's like seeing 50 years into the future. These guys backed up the central SQL repository by using SQL replication, in the background, to the matching installs on every single workstation set up in the network. They wandered in with a few files on a USB stick and these went on all the workstations, which then quietly handled their required update downloads while we were screaming at firewalls and tearing our hair out. The overall software experience is simply superb.

Of course, we're not quite there when it comes to a like-for-like comparison, because we haven't yet attempted to load up all that historic data, which brings with it the unquantifiable risk of repeating the initial snafu perpetrated by that paid-by-the-hour SQL administration "expert" some time in 2021. I'm taking the view that the earlier need to accommodate all those years of sales and customer identities was actually somewhat under-used and over-stated when it came to the actual daily life of the business; besides which, they still had the old databases (however broken) and ways of opening them remotely thanks to a remote desktop server.

My suspicion is that the original failure of the jobbing SQL updater was mostly the cause of the later trouble with the database itself. It remains a suspicion, though, as my experience suggests you can abuse and ignore SQL databases to the point where they're near impossible to kill – in which case, I'm totally at a loss as to how he managed to destroy this one so completely.

ABOVE A database has been causing headaches all round



"I'm totally at a loss as to how he managed to destroy this SQL database so completely"



BELOW Whenever you mess around with a SQL database, always take a backup

The lessons here are intriguing. I was initially surprised by the failure of the contract owner (the software company) to act defensively, whether that was by asking the on-site crew to take extra backups, or whether it thought its subcontractor was going to include that in his to-do list. In any case, it seemed clear the guy who broke it was a freelancer, and speaking as another freelancer, the first time I touch a company's servers, I'm going to come away with a thorough understanding of how to trip off an extra backup and the last time anyone tried to achieve a complete restore, too.

It reminds me why big IT shops act cautiously and slowly. It takes a rare kind of catastrophe to make a high-revenue customer switch software vendors, which explains all that caution and especially the idea that everything they do or buy has to go through a whole series of different tests, to see whether it might disrupt the moneymakers in any way. We were at the mercy of a risk-taker, fundamentally, without the prospect of proper recovery to either the status quo before the ill-considered update or of recouping the lost costs incurred. Is it about time I gave up my habit of discouraging small business operators from running their shop like it's a mega-corporation?

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RETRO

Inspirational stories from computing's long-distant past

Return of the Atari 400

The Atari 400 has been revived 45 years after its original release. David Crookes talks to the company that made it happen

ABOVE THE400 Mini revives 1979's iconic Atari 400

In the past, some computer firms looked to create machines for the masses. Others sought to produce systems aimed at businesses. But Atari, hot on the heels of a string of arcade hits and the VCS/2600 console, decided its first home computer would be aimed at a younger audience so, as well as considering what would go inside, its creators paid great attention to producing a head-turning, child-friendly design.

This was unusual. Most companies believed that games devalued computers – Sir Clive Sinclair was well known to dislike them and preferred people to be productive. Atari, however, could see why people would want to enjoy games. "Play all of your favourite computer games in dynamic colours, sound and amazing graphics," its adverts shouted.

To attract kids to the product, Atari opted for spacecraft-like styling in beige, orange and brown. It sought to persuade parents that this would be a fabulous first computer by giving it a tactile, pressure-sensitive membrane keyboard, which proved perfect for small, sticky fingers. Aside from preventing crumbs and other debris from accumulating, the keyboard was fixed, preventing the keys from being pried away and swallowed.

The Atari 400 wasn't particularly powerful. It shipped in 1979 with an initial 8K of RAM, 12K ROM and a MOS Technology 6502 CPU running at 1.79MHz. It had a display resolution of 320 x 192 pixels, 128 colours, a cartridge slot and four controller jacks. When it was covered in *Creative Computing* magazine in April 1979, the journalist pointed out that it could be used by people "with no prior computer experience". But that's not to say the machine was a lightweight.

As the magazine also suggested, the Atari 400 (and the higher-end Atari 800, which had a second cartridge slot, RAM upgrades to 48K and a conventional keyboard) was also capable of meeting "sophisticated needs". For starters, there was a whole raft of serious software aimed at helping users with their finances and word-processing needs. It could also assist with schoolwork, which *Creative Computing* said was "especially impressive given Atari's heritage as a game company".

Games certainly came thick and fast for the machine. There was a wonderful port of Nintendo's *Donkey Kong*, for example, which was far superior in looks to the Atari VCS console version. The computer was also the lead platform for iconic titles such as Electronic Arts' *The Seven Cities of Gold*, which sold more 100,000 copies, and *Archon: The Light and the Dark* which was dubbed a "landmark in the development of computerised strategy games".

> "There was a whole raft of serious software aimed at helping users with their finances and word-processing needs"

There was the space combat sim *Star Raiders*, which influenced the development of *Elite* and *Wing Commander* as well as Ozark Software's *M.U.L.E.*, and used all four joystick ports. Together with a ton of exclusives such as *Juice!* and the dungeon crawl maze game *Dandy*, which led to the creation of *Gauntlet* and included a level editor, there was much to occupy young minds. The hope – certainly among parents, we'd guess – was that they would then dig around and see what else their computer could do.

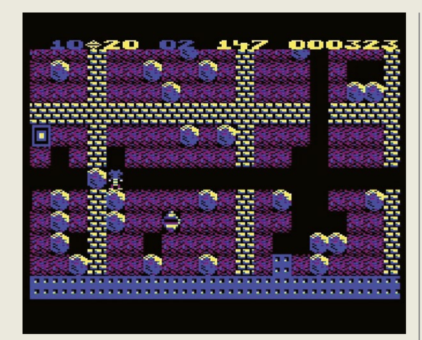
For those inclined to tinker, the Atari 400 allowed the use of Atari BASIC (which came on a cartridge), ensuring little fingers could try their hand at programming. Or, at the very least, type out listings published in magazines. Users could also attach a printer, a light pen or, if they wished to make use of cassettes, the Atari Program Recorder, which was designed to match the Atari 400's unique style.

Comeback kid

We honour the Atari 400 for a reason. It's made something of a comeback recently as the latest in a growing line-up of mini consoles created by Retro Games Ltd. It's true



BELOW THE400 Mini lets you run games and, via a USB stick, other software too







that when the company announced that it had been working on a version of this particular machine it initially raised eyebrows, mainly because it wasn't the biggest-selling 8-bit computer by any stretch of the imagination (estimates suggest sales of 800,000, compared to the Commodore 64's 17 million or so). But the more that enthusiasts dig, the more they're coming to appreciate what the 400 had to offer. It's been taken to a whole new set of hearts.

Usually when a miniature version of a retro computer or console is announced, it sails on a wave of nostalgia. In this case, THE400 Mini, as the new product is called, has been tapping into people's curiosity. "The Atari 400 was iconic for its time and there was nothing that looked like it on the market," explained Darren Melbourne, director and co-founder of Retro Games. "As a differentiator, from an aesthetic point of view, I think it absolutely ticked all the right boxes."

Prior to working on a small-form 400, Retro Gamers had concentrated on reviving products that had been created by Commodore. It released THEC64 Mini in 2018, followed it up with a full-size version two years later, developed a new VIC-20 in 2021 and, perhaps most ambitiously, sold a tiny Amiga called THEA500 Mini in 2022. In doing so, it has established a pattern. The small machines don't have working keys, whereas the larger ones have fully functioning keyboards.

This is the case with THE400 Mini. Size aside, the keyboard looks just like the original, with every key faithfully replicated and positioned. Its texture means the keyboard also feels the same as the machine created 45 years ago. Your fingertips will tingle as they're run across it.

The authenticity extends to the four function keys to the right of the keys and to the working LED power light that nestles neatly in the middle of them. In fact, the only real aesthetic difference you'd spot between the old and new versions – at first glance anyway – is the logo, since the Atari 400 name has been replaced by THE400. You'd have to poke around more keenly to see the other changes, and that's just how Retro Games Ltd wanted it.

Replicating a classic

Recreating a machine from old for a new audience isn't easy, particularly when the eyes of keen and expectant retro collectors appear to be bearing down on every aspect of the process. Even the first step – getting hold of an Atari 400 in this case – isn't as straightforward as you'd imagine. "We needed to find one in reasonable condition to use as a reference point, but locating a decent one was difficult," said Retro Games co-founder and managing director Paul Andrews. "Once we had one, though, we could start the process of measuring the machine and creating a basic CAD drawing which Chris Smith [CTO at Retro Games] could turn into a more usable CAD."

This entailed being incredibly precise. "One of the things we pride ourselves on is our attention to detail," Smith explained. "As Paul said, we got hold of a big 400 and literally took it apart, measuring every angle, every recess, every single thing down to tenths or hundredths of a millimetre. We then had to decide the extent to which we were scaling the original machine down and what impact it would have on, for example, box sizes. A centimetre difference when you're scaling down can make an insanely big difference to, say, the number of units you'd be able to get on a container shipping from China. Our decisions were made with the goal of manufacturing to a high-quality level."

Such decisions had to extend to the electronics powering the new machine – an ARM Cortex-A7 CPU, with 256MB of RAM and 128MB of flash memory – and the team had to swap the controller jacks of old with USB-A ports while adding other such modernities as a USB-C power socket and an HDMI output. Unlike the original, which connected to a CRT television, the new machine needed to be hooked up to a set capable of displaying at least 720p resolution. "THE400 Mini has all-new electronics so we had PCBs and modern connections to consider," Smith said.

Something the team has long known is that it's difficult to take old tech and put it on a single chip. "These older machines were full of bespoke chipsets designed for one job and one job only," Melbourne said. "And because they aren't being manufactured any more, there's little to no reference points for schematics." To get around that, THE400 Mini makes use of emulation. "Chris basically rewrites everything apart from the drivers," Melbourne said.

One of the biggest headaches, however, was colour-matching. Over time, plastic begins to weather, with white ABS plastic cases, for example, potentially turning yellow or brown due to the presence of a flame retardant called bromine, which becomes unstable when exposed to UV light. Retro enthusiasts will often use hydrogen peroxide to remove the free bromides and restore the original colour, but the team behind THE400 Mini needed to be sure that what they were seeing was faithful.

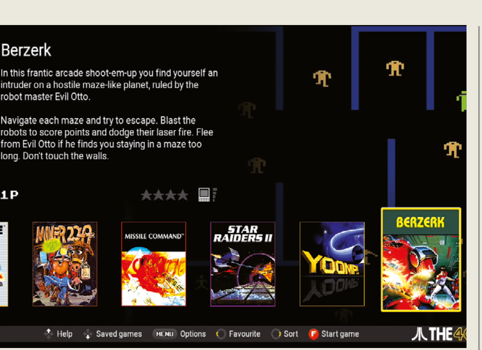
"Once we [had] found the best Atari 400 we could, understanding that even the best examples will have aged, we looked at the internal plastic for the best colour reference," Andrews said. "But we were also dealing with manufacturers in China and screens never give a good

ABOVE THE400 Mini's built-in games include (l-r) *Boulder Dash*, *Berzerk* and *Missile Command*

ABOVE The keyboard has been faithfully recreated but the keys won't work no matter how hard you press



BELOW Retro Games Ltd has also refreshed the iconic CX40 joystick



colour reference – every display is slightly different," Andrews explained. "It added an extra level of complexity – colour matching is not fun."

Lots of joy

THE400 Mini comes bundled with a joystick, modelled very closely on the Atari CX40 eight-directional, single fire buttoned controller. To bring this up to date and to get around the restrictions posed by not having a working keyboard, the team added seven buttons in such a discreet way that it still feels like the original.

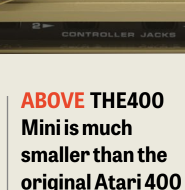
"There was no getting away from how iconic the original CX40 joystick looked – if you're creating a television show and need a bit of set dressing, you only need to put one of those joysticks in shot for it to give some context of when it was set," Smith said. "It needed modernising, though. We have a modern user interface that needs more than a single button to navigate, and the challenge was how we'd add more buttons without changing the aesthetic."

The user interface is indeed very different to what Atari 400 users would expect. Rather than have users type commands, for instance, or press button combos, you can cycle through the menu to select games. You can also choose between a 4:3 aspect ratio or a Pixel Perfect screen, which places scanlines across the screen for a CRT effect. Different games have different opinions on which works best.

To get users off to a flying start, 25 games were licensed and bundled with THE400 Mini. These include the aforementioned historic strategy title *The Seven Cities of Gold*, the sequel to *Star Raiders* and classics such as *Asteroid*, *Battlezone*, *Centipede*, *Millipede* and *Missile Command*. You also get *Basketball*, *Capture the Flag*, *Bristles*, *Encounter!*, *Airball*, *Crystal Castles*, *Yoomp!*, *Henry's House*, *Elektra Glide*, *Lee*, *Hover Bovver*, *Flip and Flap*, the multiplayer *M.U.L.E.*, *Wavy Navy*, *O'Reilly's Mine* and *Boulder Dash*.

"Licensing is an important part of what we do," said Andrews. "We always try to get the best games." Even so, investigating who owns the rights to games and securing them isn't easy. "It's painstaking," Melbourne added. "But I would say with a tiny touch of pride that I'm pretty good at rooting these things out." The process involved sitting down and noting the best games for the platform, then working out what would be viable.

"Some content is never going to be viable and some content will be difficult or near impossible to get because developers have died, companies have gone into liquidation or gaming giants have subsumed them and aren't interested in licensing them," Melbourne added. "In some cases, a licence is just too expensive, but we usually come up with a hit list that we're comfortable with and then it's about digging around the internet, Sherlock Holmes-style."



ABOVE THE400 Mini is much smaller than the original Atari 400

ABOVE LEFT The glossy front end makes it easy to access software

Extra load

Users of THE400 Mini aren't limited to the built-in games. It's possible to insert a FAT32 MBR-formatted USB stick packed with game ROMs and have the device instantly recognise and load them. What's more, games don't need to have been made purely for the 400. It's possible to enjoy games and apps created for the 800, XL and XE Atari series too. The only thing to bear in mind is that grabbing ROMs online that you haven't got the right to use isn't actually legal, but there are plenty of homebrew titles if you're wary of such things.

It's also possible to code your own software using Atari BASIC, and plenty of people are already getting stuck in, sharing their efforts online in gatherings such as The Atari 400 Mini Group on Facebook. Enthusiastic users are even going further and creating scale models of accessories such as the Atari 410 Datasette. "It was a challenge to learn some basic 3D modelling and to create an accessory in the same scale as a Mini," said one such maker, Brandon Goodrich, who used Tinkercad to create the model based on images of the Datasette before outputting it to an Ender 3 3D printer.

Another maker, Peter Kovács, has also created a mini Datasette. His version, made using Newtek LightWave 3D, is a case for a 32GB SanDisk Cruzer Blade USB stick that can be directly plugged into THE400 Mini. He's also produced a 3D model of the Atari 810 floppy disk drive, mini reproductions of the original cartridges and disks, and an Atari Tennis Paddle controller fitted with a 32GB SanDisk USB drive.

"I try to make miniatures based on the scale of the mini consoles," he said, adding that he outputs them to a Creality K1C printer. "It took me 24 hours to print a diskette drive 810 on my old Creality CR6-SE 3D printer, but now it takes a maximum of seven hours. I also study the original decals and create my own graphics in Photoshop, laminating the final printout with a cutter and gluing them to the models."

"We have a modern user interface... the challenge was how we'd add more buttons without changing the aesthetic"

Such enthusiasm among a reasonably large number of users (the Facebook group has 1,700 members) shows Retro Games Ltd is on the right track. A good number of those using the device profess to never having touched an Atari 400 before, thereby bringing the machine to a new audience. There appears to be an appreciation for the company's efforts and a willingness to forgive any hiccups along the way. The game *M.U.L.E.*, for instance, has missing graphics, but people seem more than happy to download the official complete version made available on the Retro Games website or to wait for the promised firmware upgrade.

"So long as people want what we're doing, we're more than happy to do it," said Andrews who, when *PC Pro* put a host of suggestions forward (Amstrad CPC Mini, please), simply answered: "Never say never to anything." As it happens, the company has a roadmap of future products, which includes a full-size Amiga console arriving later this year, and it would appear there are exciting times ahead. "We've grown from being three men in a shed into a very effective business," Andrews said. "And while some products won't surprise people, some of them undoubtedly will." ●





BELOW Peter Kovács has created lots of accessories for his mini console

Meet 10 intriguing characters from tech-futures past

Future technologies are built on work from decades ago. Nicole Kobie would like you to meet these should-be-famous innovators

Charles Rosen, Ivan Sutherland, Ernst Dickmanns – have you heard of any of these names? Most people likely haven't, though they should have. These are the geniuses behind remarkable engineering firsts and tech created decades ago that are still used today.

AI, robotics, AR and driverless cars may all feel very now, but they've all been decades in the making. And once a few decades have passed, it's easy to forget the people who first came up with the ideas that are powering what we'll be using tomorrow (or whenever driverless cars are actually available).

While writing a book about the history of future technologies, I met – sometimes over email, other times via university archives – a collection of inventors and engineers who managed remarkable feats well before computers could match what was in their imaginations. Their work didn't necessarily lead to flying cars or AI-powered robot butlers, but we still don't have that now. Let's meet ten geniuses from decades past who should be remembered by the tech industry.



"The systems developed using Shakey went on to power satnav software, robotic vision and even the Mars Rover"

Charles Rosen

I can't choose which is my favourite story about Charles Rosen; there are just too many. But first, some context. From 1966 to 1972, Rosen led a remarkable project at the Stanford Research Institute (SRI), building a robot called Shakey that could navigate through a warren of offices, make its own decisions and even learn from previous tasks, all using AI. None of that sounds impressive today, but this was the first time any of those capabilities had been accomplished, let alone brought together alongside computer vision, natural language processing and more. The systems developed using Shakey went on to power satnav software, robotic vision and even the Mars Rover.

And it was all in a big, hulking robot – described by one team member we'll meet in a moment, Helen Chan Wolf, as a dishwasher on wheels – that Rosen dubbed Shakey, because of how it much it shook when it moved. The man had a sense of humour that is much lacking among tech geniuses these days.

Indeed, when Rosen needed funding for Shakey, he applied to DARPA-predecessor ARPA, part of the US Department of Defense. And that gives us my first favourite Rosen tale: to catch their attention, he claimed that Shakey could be a "mobile automaton for reconnaissance" – in short, a spy robot – and even claimed it would be able to handle two or three guns. To be clear: Shakey shook constantly, was a slow-moving rolling machine that moved large blocks around a lab, and had no arms.

After the Shakey project ended, Rosen founded Machine Intelligence Corporation – while it eventually failed, work at the company led to Symantec – and later ran a winery overlooking Silicon Valley. Born in Canada in 1917, he passed away in 2002. Shakey can be seen at the Computer History Museum in Mountain View, California.



Helen Chan Wolf

Before Shakey, Chan Wolf worked on early versions of computer facial recognition, back when computing required punch cards. She then took a job as a programmer alongside Rosen at SRI on the Shakey project, focusing on using computer vision to allow the robot to see its surroundings and algorithms to pull locations from images.

One of her colleagues on the Shakey team, Peter Hart, argues that she should be known as the "Ada Lovelace of robotics" as she's quite possibly the world's first robotics programmer. Shakey was, after all, the first smart robot.

Ivan Sutherland

Born in 1938, Sutherland first gained renown in 1963 for Sketchpad, software that allowed the user to draw using a light pen and was one of the first graphical user interfaces – it's been called "one of the most influential computer programs ever written by an individual". Two years later, Sutherland published a paper called "The Ultimate Display", laying out what we would now recognise as virtual reality. Three years later, in 1968, the Harvard professor gathered up a team of students for a summer project to bring that paper to life, and they built a VR headset.

Really, it was augmented reality, though neither term had been coined yet. The head-mounted display, as Sutherland called it, showed a virtual image in the wearer's line of sight; they could move around it to see the object from multiple angles. Forget GPUs and fancy graphics, this was powered by a room-sized computer, but even then, additional specialist hardware was required to show a simple line drawing of a cube.

Sutherland didn't bother further developing AR or VR, but he became a director at DARPA, founded a computer imaging company, and pursued research in asynchronous systems. He's won too many awards to list, but they include the 1988 Turing Award.



Wilson Greatbatch

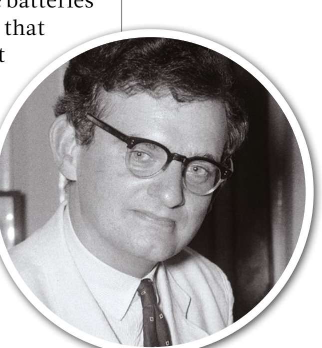
Early versions of pacemakers were plugged in at the wall, limiting a patient's movement; subsequent models had batteries, but were worn on a belt with wires connecting through the skin. The first wholly internal pacemaker was implanted in Sweden in 1958, but lasted only three years – the technology wasn't quite ready.

Enter Wilson Greatbatch. He was at the forefront of implantable pacemakers; after his team published details of their first round of implants, it was just five years before they became the de facto way to fix hearts.

But a problem remained: power. These used batteries, of course, but they only lasted two years – and given that the average survival rate of a pacemaker patient was six years, that meant three surgeries. So Greatbatch set his sights on finding a better battery, considering everything including plutonium. Eventually he found a company that made batteries using lithium and salt; after that design, he had a battery that could last 100 years – and solid-state lithium batteries eventually became the default for our gadgets.

ABOVE Research into early pacemakers led to lithium batteries

James Lighthill



In 1973, James Lighthill, then the Lucasian professor of applied mathematics at Cambridge University, took on a thankless role in relation to AI: telling everyone it wasn't very good, and may never be.

The history of AI is filled with hype, and the same was true in the 1960s and 1970s; though the technology was much less well developed and computing power was seriously lacking, there was already discussion about what to do when AI became sentient. Lighthill was asked to take a look at the sector and assess its progress. "Most workers in AI research and in related fields confess to a pronounced feeling of disappointment in what has been achieved in the past 25 years," the report said, adding: "[In] no part of the field have the discoveries made so far produced the major impact that was then promised."

That report is often blamed for the ensuing "AI winter", in which funding was pulled and research slowed. But Lighthill was right: everyone needed to calm down. It's not easy being the only cynic in the room, but when it comes to AI hype, such honesty is desperately needed.

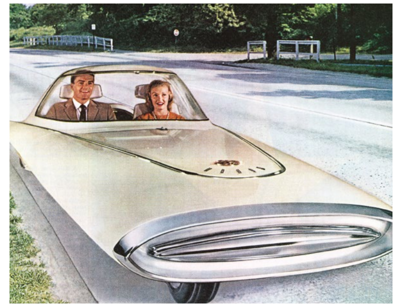
Ernst Dickmanns

In 1987, a van sped down an empty stretch of the autobahn at 96km/h – and no-one was at the wheel. A few years later, students picked up dignitaries from Charles de Gaulle airport, and when they hit the autoroute towards Paris, the car took over the driving. Shortly thereafter, the system was tested on a road trip that stretched from Munich, Germany to Odense, Denmark, with the car handling 95% of the driving, including passing others and changing lanes.



"Forget Silicon Valley. The true home of driverless cars is Munich, as that's where Ernst Dickmanns led these projects"

Forget Silicon Valley. The true home of driverless cars is Munich, as that's where Ernst Dickmanns led these projects – decades before Google et al jumped into the technology. Dickmanns' system used computer vision and modelling to navigate roads, travelling at speeds many times faster than rival academic projects. While the project was eventually shuttered due to funding constraints, the ideas created and tested are still in use today, and Dickmanns deserves the



LEFT The first "VR headset", created by Ivan Sutherland in 1968

RIGHT Driverless cars first appeared on German roads in 1987

title of "father of driverless cars" more than anyone else. Sorry, Elon.

Moulton Taylor

Taylor loved to fly: he earned his pilot's licence as early as locally possible, at just 16. He spent



the Second World War making missiles fly, but afterwards declined to continue the work in the defence industry because, as he later told a journalist, "I just decided not to spend the rest of my life making things to kill people".

Instead, he built the Aerocar. Picture a cute toy car with rounded corners and bright colours, towing a trailer – and inside that is the tailpiece of a plane and a set of wings, which could be plonked onto the car for flight in just three minutes. It worked well enough to win certification from US air authorities in 1956, for both road and air travel – in other words, the Aerocar was the first certified flying car. Taylor failed to sell enough vehicles to bring it into production, but it remains a dream many are still trying to fulfil today – so far, with less success.

George Devol

Factories are filled with robotic arms assembling everything from cars on down. And that's largely because George Devol went to the right cocktail party in Connecticut in 1956. There, he happened to chat to Joe Engleberger about an idea for a "programmed article transfer device" that could handle repetitive work – and the pair joined forces to build Unimation, the world's first robotics company.

The first product was the Unimate, a hulking box with a programmable, jointed arm that could manage jobs such as die-casting in car factories. By taking on the worst, most dangerous work, such early robots dodged complaints that they took human jobs. Now, more than a million robots are at work in the car industry globally, with double that employed in manufacturing across other industries. No wonder Devol is considered the "grandfather of robotics", but he's also known as one of the co-creators of one of the first commercial cooking machines to use microwave technology – the Speedy Weeny, which heated up hotdogs in train stations. Truly a fine legacy.

Jean Bertin

Elon Musk wrote a PDF lightly detailing hyperloops. Jean Bertin built an Aérotrain. The ideas are similar, to an extent: trains can run faster and more efficiently if you reduce friction. Hyperloops run in a vacuum-sealed tunnel, while ideas such as the tracked hovercraft that was designed in the UK in the 1970s aimed to run trains on a cushion of air. Over in France, Bertin took that idea and applied his aerospace training to create a monorail-style train that rode a cushion of air and was driven forward by a propellor – it was like a grounded plane.

The first half-scale model in 1964 didn't go fast enough with propellors, so Bertin swapped them out for rockets. With full-scale prototypes in the early 1970s, Bertin topped 430km/h; it took nearly 50 years for a hyperloop team out of the Technical University of Munich to top 463km/h in 2019. Unlike hyperloop companies of today, Bertin actually built proper tracks, with one that stretched 18km. But that was the limit of what the French government was willing to invest, and instead, the nation has standard high-speed trains instead – they don't require aerospace rockets or monorail tracks, after all.

LEFT Moulton Taylor shows off the world's first flying car

"With full-scale prototypes in the early 1970s, Bertin topped 430km/h; it took nearly 50 years for a hyperloop team to top 463km/h in 2019"

Jacques Vidal

There's another technology that Musk is focused on now that's been long in the works: brain-computer interfaces (BCI). And



RIGHT Implants using brain-computer interfaces were first trialled in the 1980s

though Musk's Neuralink has successfully placed implants into the brain of animals – a procedure that hasn't always ended well for the creatures – as well as a human, Jacques Vidal got there first.

Vidal, a researcher at UCLA, first published a paper laying out such brain implants in 1973. Indeed, that paper marks the first time the term "BCI" was used in academia. It was another 15 years before the first animal implants, with humans following in 1998, with subjects eventually able to control a cursor to navigate a digital maze – all decades before Neuralink arrived. Plenty of other researchers have achieved the same since, Musk's team included, though we remain a long way off from using such BCI implants to cure disease – or send messages hands-free with the power of our brains. ●







FAR LEFT The Unimate robot was put to work on the GM assembly line in 1961

LEFT The rocket-propelled Aérotrain reached speeds of 430km/h long before modern hyperloops



Next month

ON SALE
Thursday 4 July

Features



Photoshop's AI secrets

Adobe has quietly been adding sensational AI features into its professional imaging software, but how do you actually use it? Barry Collins reveals all.

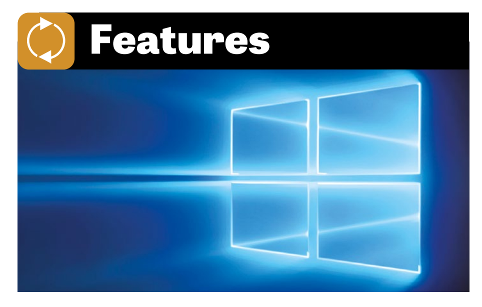
Features



Build your own Dropbox

Stop paying for cloud storage! We show you how to set up your own personal cloud for free, with easy file syncing, secure sharing – and no limits on how much you can store.

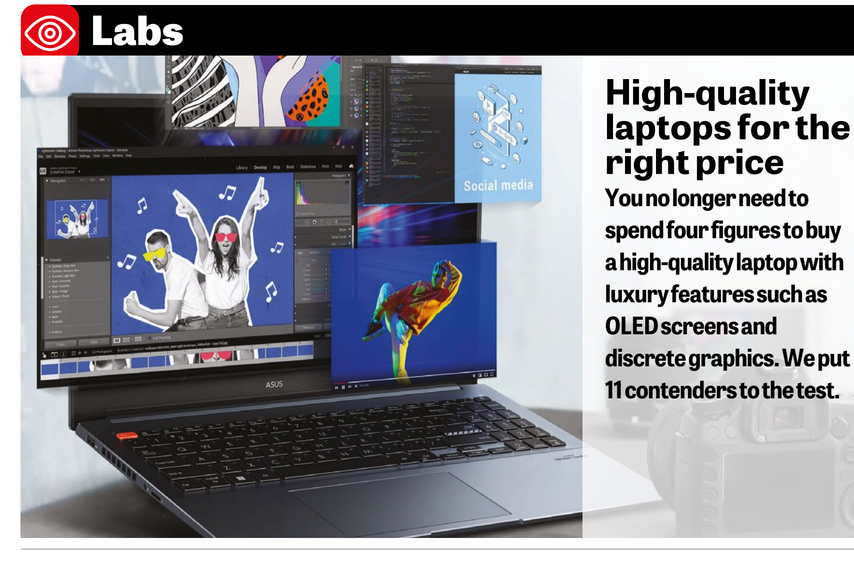
Features



Keep Windows 10 forever

Not won over by Windows 11? We explain how to move Windows 10 into a secure virtual machine that you can keep using after an upgrade.

Labs



High-quality laptops for the right price

You no longer need to spend four figures to buy a high-quality laptop with luxury features such as OLED screens and discrete graphics. We put 11 contenders to the test.



Retro

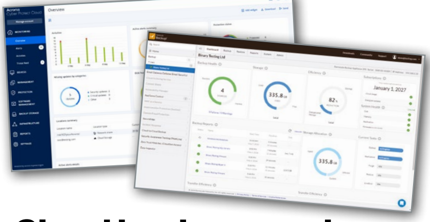


Farewell to the Z80

After 40 years of service, the faithful Z80 processor is no longer being made. We celebrate its birth and enduring success, and explain why it isn't yet game over.



The Network



Cloud backup services

Whether it's through attack or error, your business data is always at risk. Dave Mitchell explains how cloud services can add extra protection.



Futures

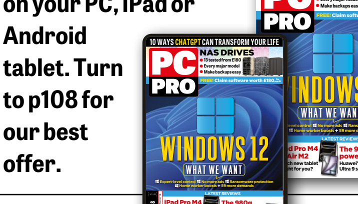
Control your computer with your face and head



Countless eye-tracking and brain-wave sensing technologies come and go each decade, as companies seek to ditch the mouse and keyboard. We share our favourites – and what's coming next.

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The internet doth protest too much at too little, says Jon Honeyball

The right to protest is a very important part of modern society. Amid the various checks and balances that tend to keep everyone moving in the same direction, protesting has always been a vital avenue of expression.

One memorable example was John Lennon and Yoko Ono's week-long "bed-in" at the Amsterdam Hilton Hotel in 1969. Each day reporters would come to visit the couple, and report their views on the Vietnam War (among other things). This is exactly the sort of protest that appeals to me, especially if the press can be kept outside while room service remains available at all times.

Other protests have taken more sombre forms. In 1963, the Vietnamese Mahayana Buddhist monk Thích Quảng Đức burned himself to death on the street in Saigon, protesting against the oppression of Buddhists. More recently, Maxwell Azzarello took his own life in a similar way outside a Manhattan courthouse at the start of Donald Trump's recent trial, albeit for less understandable reasons.

Such extreme gestures, thankfully, are the exception. Most protests I see today are entirely online affairs – individuals bombarding social media with anger and outrage. The idea is that simply generating noise on the internet might be enough to force an organisation or person to back down, and sometimes it is. Yet I find myself wondering whether the participants really care about the cause, or just enjoy the performance of protesting.

Here's a recent example: last month, to promote its new thinner-than-ever iPad Pro models, Apple made an advert showing musical instruments and art supplies being crushed in a big industrial press. At the end of the ad, the press lifts to reveal the new tablet in their place, as a voiceover declares: "The most powerful iPad ever is also the thinnest". The release of the video prompted an immediate storm online, as commentators from all walks of life rushed to condemn the imagery. Film-maker Justine Bateman demanded: "Why did Apple do an ad that crushes the arts?", and went on to bemoan how tech and AI means to "destroy the arts and society in general". That notable expert of everything, Hugh Grant, described Apple's vision as "the destruction of the human experience. Courtesy of Silicon Valley."

Apple quickly climbed down and withdrew the advert. "We missed the mark with this video," it said in a statement, "and we're sorry." But was the outcry really justified? I don't recall such a furore when The Who used to regularly smash their instruments on stage, or when Jimi Hendrix set fire to his guitar while performing at Monterey International Pop Festival in 1967.

It cuts the other way too: protesters are using the internet to create their own controversies. It's easier than ever to reach a huge audience – just record yourself on your phone doing something attention-grabbing, such as throwing soup at a priceless painting or trying to hammer and chisel your way into the Magna Carta, and it can be distributed around the world within seconds.

Or, stage a sit-in at a university, with demands including "vegan and gluten-free food". It might have been smart for those protestors to bring their own supplies, along with respirators, umbrellas and skater helmets, but then their additional requests for EpiPens and non-steroid inhalers suggests a certain lack of advance planning.

Such activities might be amusing, in a "bed-in" way, if they weren't so sad. But little of it has any connection to the real world: the paintings and Magna Carta were appropriately protected, and never in serious danger – and the protesters knew that. But in that case, why target beautiful, irreplaceable things in the first place?

I suspect that's not a question the protestors gave much thought to, because it's all just so easy, so fast-food to complain today. Get angry, find an appropriate hashtag, pull the pin on your outrage hand grenade, and roll it into the seething mass of social media. Then go home for dinner and a nice cup of tea, because today's outrage has no lasting meaning anyway.

> "The idea is that simply generating noise on the internet might be enough to force an organisation or person to back down, and sometimes it is"

And this makes it all the more puzzling when corporations cower and backtrack with mumbled apologies. I find myself wondering whether Apple intentionally created an advert that it knew would stir up controversy, just to attract attention.

Only the marketing experts can answer that, and to be honest I'm not sure which idea is more annoying – a three trillion-dollar company feeling the need to cave in to shouty online voices, or deliberately planning for events to play out this way.

Don't misunderstand me. Protest has its place, but it comes with responsibilities and consequences. It has to: otherwise, it's just shouting into the void.

Jon Honeyball has been a contributing editor at *PC Pro* since issue one, during which time he has staged over 10,000 successful bed-in protests. Email jon@jonhoneyball.com